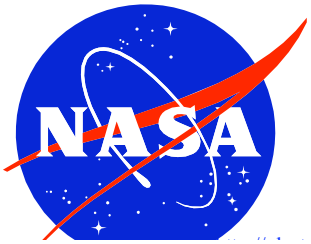
GSSC-0003

GAMMA-RAY LARGE AREA SPACE TELESCOPE (GLAST)

GLAST SCIENCE SUPPORT CENTER DESIGN DOCUMENT

July 7, 2004



GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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GAMMA-RAY LARGE AREA SPACE TELESCOPE
(GLAST)

GLAST SCIENCE SUPPORT CENTER
DESIGN DOCUMENT

May 20, 2004

NASA Goddard Space Flight Center

Greenbelt, Maryland

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REVISION STATUS

This document is controlled by the GSSC internal document configuration management.

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Table of Contents

1 Introduction

1.1 Purpose

This document presents the design of the GLAST Science Support Center (GSSC). Covered are the software, databases, and hardware needed to support all aspects of the GSSC activities described in the GSSC Functional Requirements Document.

1.2 Scope

This document presents the design of the GSSC systems—software and hardware—that are under the GSSC's control. We assume that the reader is familiar with the GLAST mission and the GLAST ground system, and therefore do not provide this background information; the reader is referred to the PDMP and the Operations Concept Document.

A large fraction of the GSSC's efforts will be devoted to the development of the Standard Analysis Environment (SAE), the tools for analyzing LAT data. The definition of the SAE is a joint GSSC-LAT instrument team effort, but the management of the development effort is a LAT team responsibility, although the GSSC is providing a large fraction of the resources. Therefore this document does not cover the design of the SAE or its components.

The SAE burst tools will also handle GBM spectral analysis. Only a small number of GBM-specific tools will be necessary. As with the responsibility of the LAT team for the LAT tools, the GBM team is responsible for developing the GBM tools, but the GSSC is involved in defining and developing these tools. Since their description does not yet exist in a separate document, this document includes a description of the GBM tools.

1.3 Applicable Documents

The following documents contain information relevant to this plan:

- "GLAST Project Data Management Plan" (PDMP), 433-DMP-0002
- "GLAST Science Support Center Functional Requirements Document," 433-RQMT-0002
- "GLAST Science Support Center Development Plan," GSSC-0001
- Standard Analysis Environment Definition Document
- Operations Data Products ICD
- Science Data Products ICD

2 GSSC Data Table

The following data tables show the data that the GSSC will receive from the other Ground System elements (GIOC, LIOC, and MOC) and the names of the GSSC databases in which they will be stored. The data flows by which these data reach the GSSC, the policies regarding access to the data, and the disposition of the data after the GSSC is disbanded are all described in the PDMP.

Table 2-1: GBM Products

GSSC Database	Product/ Identifier	Description	Delivered	Production Latency	Size (bytes)
GBM CTIME	GBM CTIME GS-001	Counts in 8 channels accumulated every 0.256s	Daily	1 day	
GBM CSPEC	GBM CSPEC GS-002	GBM CSPEC data (counts in 128 channels accumulated every 8.192 s)	Daily	1 day	250 M
GBM Burst Data	Burst trigger data GS-003	Time-tagged counts from triggered events, plus 4000 s of continuous data centered on trigger time and appropriate response functions	Per burst	1 day	20–35 M
GBM timeline	As-flown GBM timeline GS-005	Command history, instrument status & configuration, housekeeping. Includes history of detector gains & energy resolutions	Weekly	1 day	3.5 M
GBM DRM Data	Instrument response calibration GS-006	Tables of fiducial detector response parameters from which burst-specific DRMs are calculated	On update	N/A	50 M
Burst catalog—GBM	Burst catalog GS-009	List and characterization of all triggers identified as bursts	On update	N/A	TBD
GBM trigger catalog	Trigger catalog GS-007	List and characterization of all triggered events	On update	N/A	TBD
GBM burst spectra catalog	Burst spectra catalog GS-008	Catalog of deconvolved spectra	On update	N/A	TBD
Alert database-GBM	Instrument alerts MG-002	GBM instrument alerts			

Table 2-2: LAT Products

GSSC Database	Product/ Identifier	Description	Delivered	Production Latency	Size (bytes)

D1ev—Events	Event summary data LS-002	Full characterization of the events for higher-level processing	5/day	1 day	
D3—LAT IRFs	IRFs LS-004	Data necessary to calculate IRFs	On update	N/A	5 M
D2—Pointing/livetime history	Pointing and livetime history LS-005	LAT orientation and mode at TBD-second intervals; used to calculate exposure	5/day	12 hours	100 k
Alert database-LAT	Instrument alerts ML-002	LAT instrument alerts			
D6—Burst catalog—LAT	Burst catalog LS-009	LAT burst catalog	On update	N/A	100 k
LAT transient database	LAT transient data LS-007	Summary information for transient sources (GRBs, solar flares, and AGN flares) derived from LAT event data	Per transient	8 hours	100 k
D5-LAT Point Source Catalog	LAT source catalog LS-008	Table of detected gamma-ray sources with derived information	On update	N/A	10 M
Interstellar emission model	Interstellar emission model LS-010	Model for diffuse gamma-ray emission from the Milky Way, input for high-level data analysis; will be refined using GLAST data	Initial model updated periodically	N/A	40 M
Low-level LAT calibration	Low-level calibration LS-003	Calibration information for the subsystems, e.g., dead, off or noisy TKR strips, ACD tile status and PMT gains, CAL status and light sharing.	Weekly	1 week	TBD
LAT configuration history	Configuration history LS-006	LAT configuration history			
Alert database-LAT	Instrument alerts ML-002	LAT instrument alerts			

Table 2-3: MOC Products

GSSC Database	Product/ Identifier	Description	Delivered	Production Latency	Size (bytes)
Level 0 Data	Level 0 data MS-003	Level 0 data from instruments and spacecraft, science and housekeeping	5/day	1 day	

Burst Telemetry	Burst telemetry MS-003	Burst telemetry transmitted through TDRSS	Every burst		
Alert database-spacecraft	Spacecraft alert MS-002	Alert generated by spacecraft to indicate an urgent problem	As received	TBD	TBD
As-flown timeline	As-flown timeline MS-001	As-flown timeline	Weekly		

Table 2-4: GSSC Products

GSSC Database	Identifier	Description	Produced	Production Latency	Size (bytes)
D1ph—Photon summary	SS-002	List of all events that can be considered photons. Includes data necessary to calculate IRFs.	5/day		
D4—Pulsar Ephemerides	SS-001	Ephemerides of pulsars that may be GLAST-detectable	Periodically		
LAT Command Database	LS-001	Commands submitted by the LIOC to the MOC through the GSSC, whether executed or not	As needed	1 day	
GBM Command Database	GS-004	Commands submitted by the GBM to the MOC through the GSSC, whether executed or not	As needed	N/A	
Science Timelines	SS-003	Science timelines sent by the GSSC to the MOC	Weekly, with updates		
GCN Notices	SS-004	GLAST-produced GCN Notices. Captured from the GCN.	As submitted to GCN		
GCN Circulars	SS-005	GLAST-produced GCN Circulars. Captured from the GCN.	As submitted to GCN		
TOO orders	SS-006	TOO orders sent by the GSSC to the MOC	Every TOO		
TOO log	SS-007	Log of TOO communication traffic between the GSSC and the MOC	Every TOO		
Selected GI Proposals	SS-008	Abstracts of the selected GI proposals.	Yearly		

3 Databases

The GSSC will maintain a large number of databases storing the data that will be provided by the other components of the ground system, or that will be produced at the GSSC. Almost all of these databases will be accessible to the user community. The database of Level 0 data will be a notable exception; users should access these data through the IOCs. Some of these databases will be components of the Standard Analysis Environment (SAE), the suite of tools and databases that will enable the user community to analyze GLAST data, and are described separately since the management of their development is not a GSSC responsibility.

Here we understand databases to mean the collection of data, the architecture in which they are stored, and the tools used to access the data. The implementation of these databases will be described in a future document.

Table 3-1 lists the databases that are part of the SAE, and are not described in greater detail here. Table 3-2 lists the databases that are not part of the SAE. Following this table is a more detailed description of these non-SAE databases, followed by some general performance specifications. The database descriptions list the GSSC requirements they satisfy.

Table 3-1: SAE Databases

ID	Name	Description
D1ph	Photon data	List of all events that can be considered photons. Includes data necessary to calculate IRFs.
D1ev	Event data	Full characterization of the events for higher-level processing
D2	Pointing/livetime history	LAT orientation and mode at TBD-second intervals; used to calculate exposure
D3	LAT IRFs	Data necessary to calculate IRFs. Stored in CALDB.
D5	LAT Point Source Catalog	Table of detected gamma-ray sources with derived information
D7	Interstellar emission model	Model for diffuse gamma-ray emission from the Milky Way, input for high-level data analysis; will be refined using GLAST data
D4	Pulsar ephemeris	Ephemerides of pulsars that might be detectable by GLAST

Table 3-2: Non-SAE Databases

ID	Name	Description
TBD	Level 0 database	Level 0 data from the instruments and the spacecraft
TBD	GBM DRM Data	Tables of fiducial detector response parameters from which burst-specific GBM DRMs are calculated. Stored in CALDB.
TBD	GBM CTIME database	GBM CTIME data (counts in 8 channels accumulated every 0.256s).
TBD	GBM CSPEC database	GBM CSPEC data (counts in 128 channels accumulated every 8.192 s).
TBD	GBM Timeline	Configuration of the GBM over a given time range.
TBD	GBM Burst Data	Time-tagged counts (TTE) from triggered events, plus 4000 s of continuous data centered on trigger time and DRMs

TBD	Alert database-LAT	LAT alerts
TBD	Alert database—GBM	GBM alerts
TBD	Alert database—spacecraft	Spacecraft alerts
TBD	Burst catalog—GBM	Description of each burst detected by the GBM
TBD	Burst catalog—LAT	Description of each burst detected by the LAT
TBD	GBM trigger catalog	Description of each GBM trigger
TBD	GBM burst spectra catalog	Catalog of spectral fits to each GBM burst
TBD	LAT transient Database	Summary information for transient sources (GRBs, solar flares, and AGN flares) derived from LAT event data
TBD	LAT Command Database	Commands submitted by the LIOC
TBD	GBM Command Database	Commands submitted by the GBM
TBD	Science Timeline Database	Timelines the GSSC sent to the MOC
TBD	As-flown timeline database	As-flown timelines
TBD	LAT Configuration history	Accesses the LAT configuration history
TBD	Burst Telemetry	Burst telemetry sent down over TDRSS
TBD	GCN Notices	GLAST-produced GCN Notices
TBD	GCN Circulars	GLAST-produced GCN Circulars
TBD	LAT Calibration	Low level LAT calibration data
TBD	TOO Orders	TOO orders submitted by the GSSC to the MOC from D28
TBD	TOO Log	Log of TOO communications between the GSSC and the MOC
TBD	GI Proposals	Abstracts of the accepted GI proposals

3.1 Level 0 Database

Contents: Level 0 data from the instruments and the spacecraft, both science data and housekeeping.

Requirements: 5.7.1.1, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Level 0 data (MS-003)

Search criteria: AppID and time

Output: Files in native Level 0 format

Comments: The Level 0 data will be stored in files by AppID, which indicates the type of data and its source. The Level 0 data will not be accessible by the user community through the GSSC.

3.2 GBM DRM Data

Contents: Tables of fiducial detector response parameters from which burst-specific GBM DRMs are calculated

Requirements: 5.7.2, 5.7.4, 5.7.4.2

Source data product: Instrument response calibration (GS-006)

Output: RSP files

Comments: These data are stored in CALDB. The DRMgen tool accesses these files, and produces DRMs for specific bursts.

3.3 GBM CTIME Data

Contents: GBM CTIME data.

Requirements: 5.3.3.1, 5.7.1.4, 5.7.2, 5.7.4, 5.7.4.2

Source data product: GBM CTIME (GS-001)

Search criteria: Time and detector

Output: PHAII files

Comments: The CTIME data consists of GBM counts in 8 channels accumulated every 0.256 s from each GBM detector.

3.4 GBM CSPEC Data

Contents: Extracts GBM CTIME data.

Requirements: 5.3.3.1, 5.7.1.4, 5.7.2, 5.7.4, 5.7.4.2

Source data product: GBM CSPEC database (GS-002)

Search criteria: Time and detector

Output: PHAII files

Comments: The CTIME data consists of GBM counts in 128 channels accumulated every 8.192 s from each GBM detector.

3.5 GBM Timeline

Contents: Configuration of the GBM over a given time range.

Requirements: 5.3.3.1, 5.7.1.4, 5.7.2, 5.7.4, 5.7.4.2

Source data product: As-flown GBM timeline (GS-005).

Search criteria: Time range, detector configuration

Output: Webpage, ASCII file

Comments: This information can be used to determine the state of the GBM during a burst or to identify when the GBM was in a given configuration (e.g., PMT gains) during a given time range.

3.6 GBM Burst Data

Contents: GBM Time Tagged Events (TTE), continuous data and DRMs for each burst

Requirements: 5.3.3.1, 5.7.1.4, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Burst Trigger Data (GS-003)

Search Criteria: Burst name, GBM trigger

Output: FITS files with TTE data, DRMs or one of the continuous data types.

Comment: The Time Tagged Events (TTE) will be stored in a variant of the FT1 FITS format used for LAT photons. The extracted TTE data can be binned for spectral analysis. The extracted continuous data can be used with the TTE data to calculate backgrounds.

3.7 Alert Database—LAT

Contents: LAT instrument alerts

Requirements: 5.7.1.3, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Instrument alerts (ML-002)

Search criteria: Keywords

Output: Webpage

Comments: The same web interface may be used for all the alert databases.

3.8 Alert Database—GBM

Contents: GBM alerts

Requirements: 5.7.1.4, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Instrument alerts (MG-002)

Search criteria: Keywords

Output: Webpage

Comments: The same web interface may be used for all the alert databases.

3.9 Alert Database—Spacecraft

Contents: Spacecraft alerts

Requirements: 5.7.1.2, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Spacecraft alert (MS-002)

Search criteria: Keywords

Output: Webpage

Comments: The same web interface may be used for all the alert databases.

3.10 Burst Catalog—GBM

Contents: Characteristics of bursts observed by GBM

Requirements: 5.3.3.1, 5.7.1.4, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Burst catalog (GS-009)

Search criteria: Burst name, GBM trigger number

Output: Webpage with information on particular burst

Comments: The same web interface may be used for both GBM and LAT burst catalogs.

3.11 Burst Catalog—LAT

Contents: Characteristics of bursts observed by GBM LAT

Requirements: 5.3.3.1, 5.7.1.3, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Burst catalog (LS-009)

Search criteria: Burst name

Output: Webpage with information on particular burst

Comments: The same web interface may be used for both GBM and LAT burst catalogs.

3.12 GBM Trigger Catalog

Contents: Characteristics of each GBM trigger whether or not a burst

Requirements: 5.3.3.1, 5.7.1.4, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Trigger catalog (GS-007)

Search criteria: GBM trigger number

Output: Webpage with information on particular trigger

Comments: The access interface can be a clone of the interface to the burst catalogs

3.13 GBM Burst Spectra Catalog

Contents: Spectral fits to GBM bursts

Requirements: 5.3.3.1, 5.7.1.4, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Burst spectra catalog (GS-008)

Search criteria: burst name, GBM trigger number

Output: webpage with spectral fit parameters and lightcurves, ASCII file with spectral fit parameters, files with lightcurves (e.g., GIF).

Comments:

3.14 LAT Transient Database

Contents: LAT data for transients

Requirements: 5.3.3.1, 5.7.1.3, 5.7.2, 5.7.4, 5.7.4.2

Source data product: LAT transient data (LS-007)

Search criteria: time range

Output: webpage with information on transient

Comments:

3.15 LAT Command Database

Contents: Commands submitted by the LIOC.

Requirements: 5.4.1.6.5, 5.7.2, 5.7.4, 5.7.4.2

Source data product: LAT commands (LS-001)

Search criteria: time ranges, command mnemonics, key words

Output: Webpage or ASCII file with commands

Comments: The LIOC will send the command loads that the LIOC would like uplinked to the LAT to the MOC through the GSSC; the GSSC will vet the commands for their impact on the science timeline. The GSSC will store a copy of all such command loads, whether or not they are sent on to the MOC and whether or not they are actually executed. The command load will have a header describing the activity the load performs and commands represented by mnemonics; thus command loads can be found by time, keyword and mnemonic. Clones of the same access tool can be used to access all the command databases.

3.16 GBM Command Database

Contents: Commands submitted by the GIOC.

Requirements: 5.4.1.6.5, 5.7.2, 5.7.4, 5.7.4.2

Source data product: GBM commands (GS-004)

Search criteria: time range, command mnemonic, key words

Output: Webpage or ASCII file with commands

Comments: The GIOC will send the command loads that the LIOC would like uplinked to the GBM to the MOC through the GSSC; the GSSC will vet the commands for their impact on the science timeline. The GSSC will store a copy of all such command loads, whether or not they are sent on to the MOC and whether or not they are actually executed. The command load will have a header describing the activity the load performs and commands represented by mnemonics; thus command loads can be found by time, keyword and mnemonic. Clones of the same access tool can be used to access all the command databases.

3.17 Science Timeline Database

Contents: Timelines the GSSC sent to the MOC.

Requirements: 5.4.1.3, 5.4.1.6.5, 5.7.2, 5.7.4, 5.7.4.2

Source data product: science timelines (SS-003)

Search criteria: time range, command mnemonic, key words

Output: Webpage or ASCII file with commands

Comments: The GSSC will send the MOC sets of commands representing the science timeline. The GSSC will store a copy of all timelines, whether or not they are actually executed. Clones of the same access tool can be used to access all the command databases.

3.18 As-Flown Timeline Database

Contents: Commands actually executed by the observatory (the as-flown timeline).

Requirements: 5.4.1.3, 5.4.1.6.5, 5.7.2, 5.7.4, 5.7.4.2

Source data product: as-flown timeline (MS-001)

Search criteria: time range, command mnemonic, key words

Output: Webpage or ASCII file with commands

Comments: The MOC will send the GSSC the commands actually executed by the observatory. Clones of the same access tool can be used to access all the command databases.

3.19 LAT Configuration History

Contents: History of the LAT configuration

Requirements: 5.7.1.3, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Configuration history (LS-006)

Search criteria: Time, keywords

Output: Webpage or ASCII file with configuration

Comments:

3.20 Burst Telemetry

Contents: Burst telemetry transmitted through TDRSS

Requirements: 5.7.1.1, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Level 0 data (M-001)

Search criteria: burst name, GBM trigger number

Output: Webpage or ASCII file of burst telemetry

Comments:

3.21 GCN Notices

Contents: GLAST-produced GCN Notices

Requirements: 5.7.1.7, 5.7.2, 5.7.4, 5.7.4.2

Source data product: GCN Notices (SS-004)

Search criteria: Burst name, GBM trigger

Output: Webpage or ASCII file with GCN Notices

Comments: The GSSC will capture all GCN Notices produced by the GLAST mission. GCN Notices are fixed format messages, often giving a burst position, that is usually generated automatically (i.e., without a human in the loop) by a mission.

3.22 GCN Circulars

Contents: GLAST-produced GCN Circulars

Requirements: 5.7.1.7, 5.7.2, 5.7.4, 5.7.4.2

Source data product: GCN Circulars (SS-005)

Search criteria: Burst name, GBM trigger

Output: Webpage or ASCII file with GCN Notices

Comments: The GSSC will capture all GCN Notices produced by the GLAST mission. Circulars are human-written text giving the result of a burst analysis.

3.23 LAT Calibration

Contents: Low level LAT calibration data

Requirements: 5.7.1.3, 5.7.2, 5.7.4, 5.7.4.2

Source data product: Low-level Calibration (LS-003)

Search criteria: Time, keywords

Output: Webpage or ASCII file

Comments:

3.24 TOO Order

Contents: TOO orders submitted by the GSSC to the MOC

Requirements: 5.4.1.5.5, 5.7.2, 5.7.4, 5.7.4.2

Source data product: TOO orders (SS-006)

Search criteria: Time, keywords

Output: Webpage or ASCII file

Comments:

3.25 TOO Log

Contents: Log of TOO communications between the GSSC and the MOC

Requirements: 5.4.1.5.5, 5.7.2, 5.7.4, 5.7.4.2

Source data product: TOO log

Search criteria: Time, keywords (SS-007)

Output: Webpage or ASCII file

Comments:

3.26 GI Proposals

Contents: Abstracts of the accepted GI proposals

Requirements: 5.3.2.8

Source data product: Selected GI Proposals (SS-008)

Search criteria: Keywords (e.g., object type, specific object name, analysis technique, GI name, proposal type)

Output: Webpage

Comments:

3.27 Performance Specifications

The following are performance specifications that are good practice and in most cases flow from the requirements (which are indicated where relevant).

3.27.1 Capacity

The databases shall be constructed to store and search 10 years worth of data. (5.1.2, 5.1.5)

3.27.2 Computer Platforms

The databases shall be constructed to operate on the hardware and operating systems commonly available to the IOCs, the GSSC, and the HEASARC. (5.5.1.2)

3.27.3 Archiving at the HEASARC

The databases will be transferred to the HEASARC by the end of the GLAST mission. (5.7.5)

3.27.4 System Independence

The databases shall not use the special proprietary features of an operating system or a database management system. This will ensure portability to new systems. (5.5.1.3)

3.27.5 Database Backup Tools

The databases shall have tools for incremental and full backup of the data.

3.27.6 Database Backups

Databases into which data are ingested on timescales less than a month shall have incremental backups daily and full backups monthly, while databases into which data are ingested less frequently shall have full back ups on update.

3.27.7 Access

The databases shall be accessible in accordance with the mission's data policies. (5.7.4)

3.27.8 Query Queuing

Database queries shall be queued so that a query can be made while a previous query is in progress.

4 GSSC Ingest Software

The GSSC Ingest software system provides the mechanism by which the data transferred to the GSSC is put into GSSC databases and thereby made available to scientists. The system will ingest data automatically, to provide data in the most rapid way. There are several parts to this system: a data transfer program, a process manager, a pipeline manager, and data specific processing modules.

Table 4-1: GSSC Ingest Pipeline Software

Tool Name	Description	Source	Release
File transfer program	To transfer data from the IOCs and the MOC to GSSC	DTS from LHEA and locally developed scripts.	GSSC 1 (MOC) GSSC 3 (IOCs)
Pipeline Manager	Handles queuing for ingest program modules that process the many types of data from the MOC and IOCs, Maintains processing state information for a specified period of time. Notifies operators of error conditions.	OPUS or co-opt RXTE SOF pipeline software	GSSC 1 (prototype) GSSC 3 (full version)
Process Manager	Does automatic checking of system usage by processes, and can restart failed processes.	XTE process manager	GSSC 1 (prototype) GSSC 3 (full version)
Data Processing Modules	Perform data integrity checking, stripping off metadata, feeding databases and performing custom data processing	Custom scripts	See module release time by data product in section 4.5

4.1 File Transfer System

Purpose:
To provide an automated transfer of data between the GSSC and external interfaces. This system will handle the data availability notices, transfer, file bookkeeping, and error notification of all data files routinely transferred between the GSSC and other ground system elements.

FRD Requirements Satisfied: 5.3.3.1, 5.6.3

Interface:
A copy of the main part of this transfer program must be running at the MOC and IOCs to enable the file transfer. Notification is done by TBD.

Input:
Data Products are listed in transfer system and sent to GSSC.

Output:
a. Data products
b. A list of files transferred
c. A log of the transfer process

Description:
Data will be transferred by TBD. This system will be capable of notifying the pipeline manager that data is available for processing.

Candidate: HEASARC's DTS or FASTcopy + scripts

Software Release: 1

Testing:
1.Tests:
1.Sample file is entered into external element sending system.
2.Data received by GSSC
3.List of files transferred made.
4.File transfer logged correctly
5.Graceful handling of bad file lists
2.Files:
1.Valid Data product files
2.Corrupted file lists.

4.2 Pipeline Manager

Purpose:
To provide for automated processing of incoming data to GSSC. Data processing will be tracked through the various stages of processing. An overall processing viewer will allow an operator to view the overall state of data processing.

FRD Requirements Satisfied: 5.3.3.1, 5.6.1, 5.6.2, 5.6.3

Interface:
The system will be kicked off by a post-transfer processing command.

Input:
Data products.

Output:
a. State diagram of processing
b. Error notification
c. A log of processing

Description:
When data is available the pipeline manager will schedule processing, and run individual processing modules on the data. Any errors are logged and operators are notified.

Candidate: OPUS or XTE-processing pipeline template.

Software Release: 1

Testing:
3.Tests:
1.Sample file is entered into external element sending system.
2.Data received by GSSC
3.List of files transferred made.
4.File transfer logged correctly
5.Graceful handling of bad file lists
4.Files:
1.Valid Data product files
2.Corrupted file lists.

4.3 Process Manager

Purpose:
To provide automatic oversight of processing and resources in the GSSC. Portions of the Process Manager's resource checking code will be used by pipeline processing modules.

FRD Requirements Satisfied: 5.3.3.1, 5.6.3

Interface:
A library of code modules will provide a Graphical User Interface to operators showing the state of processing and resources.

Input:
Configuration files

Output:

a. A processing database table.
b. An error notice.
c. A log of the checking

Description:
The manager works by organizing the output of checkup cronjobs that write their results to a database log. The state of the system is displayed graphically.

Candidate: RXTE's process manager.

Software Release: 1

Testing:
1.Tests:
1. Kill a checked process – watch it restart.
2.set a disk fill threshold low enough to trigger an error notification
2.Files: None external

4.4 Ingest Data Product Specific Processing

The main work involved in providing the ingest system will be providing data specific software to perform validation, custom processing, to feed the data to databases. This section description will cover in general terms the processing which must be done to any data product. Any differences between this generic description and that for any data product will be described in the ingest data product specific sections.

The data product specific sections will describe only the:
1.Validation criteria
2.Metadata extracted
3. Custom processing
4. Software release.

4.4.1 Generic Data processing

Purpose:
To provide automatic ingest of the many types of data from the MOC and the IOCs. To perform data validation, ensuring data integrity. To do custom data-specific processing, and to place the data into searchable databases, used by guest investigators.

FRD Requirements Satisfied: 5.3.3.1, 5.6.1

Interface:
The notification (by the GSSC data transfer system) that new data has arrived.

Input:
Data Products

Output:
a. Metadata for use in either GSSC or HEASARC applications.
b. Data products put into appropriate database.
c. Custom processed data.

Description:
The following processing steps are executed for each data product:
1. Determines when new data arrives
2. Makes immediate backup of new data
3. Identifies processing needs by data type
4. Checks available processing resources
5. Schedules for processing
6. Extracts relevant metadata.
7. Performs customized data product specific processing
8. Populates databases with new information
9. Notifies Archive Manager that new data is to be archived onto permanent media.
10. Tracks each processing step with a database.
11. Logs time tagged processing information.
12. Notifies operations staff when serious errors occur

Candidate: Custom software modules to be run by the pipeline manager

Software Release: 1 (For level 0 ingest), all modules by release 5.
See data product specific listing for detailed release times.

Testing:
This descriptions covers most of the data specific testing. Any addition testing will be noted in the data product specific sections.

3.Tests:
1.Sample file sent to transfer program & its arrival must recorded correctly
2.Data validated by modules, and bad data is not processed.
3.Proper metadata extracted.
4.Data entered into appropriate database as readable data.
5.Graceful handling of corrupted files
4.Files:
1.Valid Data product file(s)
2.Corrupted data product file(s)
3.Sample final science timeline with different timeline as as-flown timeline
4.Corrupted as-flown timeline.

4.5 Ingest Data Products

The following table summarizes the data products that GSSC will ingest from external ground system elements by name, source, and database. The final column indicates the GSSC software release that will include modules to process the named data product.

Table 4-2: Ingest Data Products

Data Product	Origin	Database	Release
GS-001 GBM CTIME (Daily Version)	GIOC	GBM CTIME (D10a)	GSSC 4
GS-102 GBM CTIME (Burst Version)	GIOC	GBM Burst Data (D11)	GSSC 4
GS-002 GBM CSPEC (Daily Version)	GIOC	GBM CSPEC (D10b)	GSSC 4
GS-103 GBM CSPEC (Burst Version)	GIOC	GBM Burst Data (D11)	GSSC 4
GS-101 GBM TTE	GIOC	GBM Burst Data (D11)	GSSC 4
GS-005a GBM Housekeeping (CHK)	GIOC	GBM Timeline (D16)	GSSC 4
GS-005b GBM Diagnostic Messages (Telemetry)	GIOC	GBM Timeline (D16)	GSSC 4
GS-005c GBM Gain and Energy Resolution History	GIOC	GBM CALDB (D15)	GSSC 4
GS-006 GBM Calibration	GIOC	GBM CALDB (D15)	TBD
GS-107 GBM TRIGDAT	GIOC	GBM Burst Data (D11)	GSSC 4
GS-106 Preliminary GBM Burst Catalog Entry	GIOC	GBM Burst Data (D11)	GSSC 4
GS-009 GBM Burst Catalog	GIOC	GBM Burst Catalog (D13)	GSSC 4
GS-007 GBM Trigger Catalog	GIOC	GBM Trigger Catalog (D12)	GSSC 4
GS-008 GBM Burst	GIOC	GBM Burst Spectra	GSSC 4

Spectra Catalog		Catalog (D14)	
GS-104 GBM DRMs	GIOC	GBM Burst Data (D11)	GSSC 4
GS-105 GBM Background Files	GIOC	GBM Burst Data (D11)	GSSC 4
LS-002 LAT Events	ISOC	LAT Event Database (D1ev)	GSSC 4
LS-004 LAT IRFs	ISOC	LAT CALDB (D3)	GSSC 4
LS-005 Pointing and Livetime History Data	ISOC	Pointing/Livetime History (D2)	GSSC 4
LS-009 LAT Burst Catalog	ISOC	LAT Burst Catalog (D6)	GSSC 4
LS-007 LAT Transient Data	ISOC	LAT Transient Database (D9)	GSSC 4
LS-008 LAT Point Source Catalog	ISOC	LAT Point Source Catalog (D5)	GSSC 4
LS-010 Interstellar Emission Model	ISOC	Interstellar Emission Model (D7)	GSSC 4
LS-003 LAT Low-Level Calibration	ISOC	Low-Level LAT Calibration Database (D19)	TBD
LS-006 LAT Configuration History	ISOC	LAT Configuration History (D20)	GSSC 4?
Level 0 Data	MOC	Level 0 Database (D0)	GSSC 1
Anomaly Reports	MOC	Mission Alerts (D22)	TBD
As-flown Timeline	MOC	As-flown Timeline (D21)	GSSC 4
SS-002 Photon Summary Data	GSSC	Photon Database (D1ph)	GSSC 4
SS-001 Pulsar Ephemerides	GSSC	Pulsar Ephemerides (D4)	GSSC 4
LAT Instrument Commands	ISOC	LAT Command Database (D18)	GSSC 2
LAT Instrument Memory Loads	ISOC	LAT Command Database (D18)	GSSC 2
LAT Flight Software Loads	ISOC	LAT Command Database (D18)	GSSC 2
LAT SAA Definition Updates	ISOC	LAT Command Database (D18)	GSSC 2
GBM Instrument Commands	GIOC	GBM Command Database (D17)	GSSC 2

GBM Instrument Memory Loads	GIOC	GBM Command Database (D17)	GSSC 2
GBM Flight Software Loads	GIOC	GBM Command Database (D17)	GSSC 2
GBM SAA Definition Updates	GIOC	GBM Command Database (D17)	GSSC 2
SS-004 GCN Notices	GCN	GCN Notices (D26)	TBD
SS-005 GCN Circulars	GCN	GCN Circulars (D27)	TBD
Accepted GI Proposal Database	GSSC	Accepted GI Proposal Database (D31)	TBD
Integrated Observatory Timeline	MOC	Integrated Observatory Timelines (D32)	GSSC 3
MOC Supplied TDRSS Ephemerides	MOC	TDRSS Ephemerides (D33)	GSSC 3
GLAST Ephemeris	MOC	GLAST Ephemerides (D34)	GSSC 3
Notifications, Acknowledgements and Dispositions	MOC	TBD	GSSC 3
Requested TDRSS Contact Schedule	MOC	TBD	GSSC 3
TDRSS Forecast Schedule	MOC	TBD	GSSC 3

4.5.1 GS-001 -- GBM CTIME (Daily version)

Contents: GBM counts in 8 channels accumulated every 0.256 s from each GBM detector.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Detector

Derived:

- Time Range (UT)

Table: TBD

Browse Metadata:

Header Keyword:

- Detector

Derived:

- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.2 GS-102 -- GBM CTIME (Burst version)

Contents: 4000 sec centered on burst.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Burst Name
- Detector
- RA, DEC
- Error Box

Derived:

- Time Range (UT)
- L, B

Table: TBD

Browse Metadata:

Header Keyword:

- Burst Name
- Detector
- RA, DEC
- Error Box

Derived:

- Time Range (UT)
- L, B

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.3 GS-002 -- GBM CSPEC (Daily version)

Contents: GBM counts in 128 channels accumulated every 8.192 s from each GBM detector.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Detector

Derived:

- Time Range (UT)

Table: TBD

Browse Metadata:

Header Keyword:

- Detector

Derived:

- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.4 GS-103 -- GBM CSPEC (Burst version)

Contents: 4000 sec centered on burst.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Burst Name
- Detector
- RA, DEC
- Error Box

Derived:

- Time Range (UT)

Table: TBD

Browse Metadata:

Header Keyword:

- Burst Name
- Detector
- RA, DEC
- Error Box

Derived:

- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.5 GS-101 -- GBM TTE

Contents: GBM Time triggered events.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Burst Name
- Detector
- Energy Range (keV)

Derived:

- Time Range (UT)

Table: TBD

Browse Metadata:

Header Keyword:

- Burst Name
- Detector
- Energy Range (keV)

Derived:

- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.6 GS-005a -- GBM Housekeeping (CHK)

Contents: Housekeeping sent through the 1553 bus.

File Format: TBD

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:
Header Keyword: TBD
Derived:
- Time Range (UT)

Table: TBD

Browse Metadata:
Header Keyword: TBD
Derived:
- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.7 GS-005b -- GBM Diagnostic Messages (Telemetry)

Contents: Instrument status and configuration reported by the FSW.

File Format: TBD

Validation Criteria: Checksum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword: TBD
Derived:

- Time Range (UT)

Table: TBD

Browse Metadata:
Header Keyword: TBD
Derived:
- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.8 GS-005c -- GBM Gain and Energy Resolution History

Contents: History of the detector gains and energy resolutions. Required for calculating DRMs.

File Format: TBD

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:
Header Keyword: TBD
Table: TBD
Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.9 GS-006 -- GBM Calibration

Contents: Tables of fiducial detector response parameters from which burst-specific DRMs are calculated. These data are stored in CALDB. The DRMgen tool accesses these files, and produces DRMs for specific bursts.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

Custom Processing:

Software Release: TBD

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.10 GS-107 -- GBM TRIGDAT

Contents: The GBM burst alert data loaded into a single FITS file.

File Format: TBD

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Burst Name

Table: TBD

Browse Metadata:

Header Keyword:

- Burst Name

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.11 GS-106 – Preliminary GBM Burst Catalog Entry

Contents: Preliminary list of burst characteristics that will be included in the GBM Burst Catalog.
File Format: ASCII

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Burst Name
- Ra
- Dec
- Peak Flux
- Flux Error
- Fluence
- T50 Duration
- T90 Duration

Derived:

- Time Range (UT)

Table: TBD

Browse Metadata:

- Burst Name
- Ra
- Dec
- Peak Flux
- Flux Error
- Fluence
- T50 Duration
- T90 Duration

Derived:

- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.12 GS-009 -- GBM Burst Catalog

Contents: Lists and characterizations of all GBM triggers identified as bursts.

File Format: ASCII

Validation Criteria: Checksum, file size, file version, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Revision

Table:

- Burst Name
- Ra
- Dec
- Peak Flux
- Flux Error
- Fluence
- T50 Duration
- T90 Duration

Derived:

- Time Range (UT)

Table: TBD

Browse Metadata:

Header Keyword:

- Revision

Table:

- Burst Name
- Ra
- Dec
- Peak Flux
- Flux Error
- Fluence
- T50 Duration
- T90 Duration

Derived:

- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.
Generated Products:

4.5.13 GS-007 -- GBM Trigger Catalog

Contents: Characteristics of each GBM trigger whether or not a burst.

File Format: ASCII

Validation Criteria: Checksum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword:
- Revision

Table:
- Burst Name
- Ra
- Dec
- Duration
- Hardness Ratio
- Peak Flux
- T50 Duration
- T90 Duration

Derived:
- Time Range (UT)

Table: TBD

Browse Metadata:
Header Keyword:
- Revision

Table:
- Burst Name
- Ra
- Dec
- Duration
- Hardness Ratio
- Peak Flux
- T50 Duration
- T90 Duration

Derived:
- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.
Generated Products:

4.5.14 GS-008 -- GBM Burst Spectra Catalog

Contents: Catalogs of deconvolved spectra.

File Format: ASCII

Validation Criteria: Checksum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword:
- Revision

Table:
- Burst Name
- RA, DEC
- Flux
- T50 Duration
- T90 Duration

Table: TBD

Browse Metadata:
Header Keyword:
- Revision

Table:
- Burst Name
- RA, DEC
- Flux
- T50 Duration
- T90 Duration

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.15 GS-104 -- GBM DRMs

Contents: DRMs for the burst, one for each significantly different pointing.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Burst Name

Table: TBD

Browse Metadata:

Header Keyword:

- Burst Name

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.16 GS-105 -- GBM Background Files

Contents: XSPEC-usable background files.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:
Header Keyword:
- Burst Name

Table: TBD

Browse Metadata:
Header Keyword:
- Burst Name

Table: TBD
Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.17 LS-002 -- LAT Events

Contents: Full characterization of the events for higher-level processing.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format (FT0), number of events, number of photons, date-obs, date-end, tstart, tstop, telapse, ontime, keywords (TBD).

GSSC Metadata:
Header Keyword:
- Number of events
- Date-Obs
- Date-End
- Tstart
- Tstop

Column:
- Calib version

Table: TBD

Browse Metadata:
Header Keyword:
- Number of events
- Date-Obs

- Date-End
- Tstart
- Tstop

Column:

- Calib version

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name, keywords (date-obs, date-end, tstart, tstop, creator, software, version, recon version (array)).

Generated Products:

- Photon Summary Data (SS002)
- Monitored source data (e.g., Crab)
- Count maps
- Flux maps
- Sensitivity maps
- Light curves
- Spectra

4.5.18 LS-004 -- LAT IRFs

Contents: Tabulations or parameterizations of the effective area, energy resolution, and point-spread function of the LAT as functions of the incident photon energy and direction (with respect to the instrument), the location within the LAT of the photon conversion, instrumental parameters, and the set of background rejection/PSF enhancement cuts applied.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.19 LS-005 -- Pointing and Livetime History Data

Contents: Records of pointing, instrument mode, and livetime for regular time intervals (~30 s) (spacecraft data)

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Date-Obs
- Date-End
- Tstart
- Tstop
- Lat operation mode (on/off) - vector
- S/C longitude (deg) at start
- S/C latitude (deg) at start

Derived

- Cumulative livetime (s)

Table: TBD

Browse Metadata:

Header Keyword:

- Date-Obs
- Date-End
- Tstart
- Tstop
- Lat operation mode (on/off) - vector
- S/C longitude (deg) at start
- S/C latitude (deg) at start

Derived

- Cumulative livetime (s)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name, keywords (date-obs, date-end, tstart, tstop, creator, software, version).

Generated Products:

4.5.20 LS-009 -- LAT Burst Catalog

Contents: Lists and characterizations of all LAT triggers identified as bursts.

File Format: ASCII

Validation Criteria: Checksum, file size, file version, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Burst Name
- Number of Burst Photons
- Ra
- Dec
- Duration
- Hardness Ratio
- Spectral Index
- Peak Flux

Derived:

- Time Range (UT)

Table: TBD

Browse Metadata:

Header Keyword:

- Burst Name
- Number of Burst Photons
- Ra
- Dec
- Duration
- Hardness Ratio
- Spectral Index
- Peak Flux

Derived:

- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.21 LS-007 -- LAT Transient Data

Contents: Summary information for transient sources (GRBs, solar flares, and AGN flares) detected by the LAT. This data product is meant to serve as an alert produced when a transient is detected; therefore it will contain preliminary parameters and quite likely only partial light curves.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Transient Type (GRB, solar flare etc)
- Duration
- Object

Derived:

- Time Range (UT)

Table: TBD

Browse Metadata:

Header Keyword:

- Transient Type (GRB, solar flare etc)
- Duration
- Object

Derived:

- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.22 LS-008 -- LAT Point Source Catalog

Contents: Tables of detected gamma-ray sources with derived information.

File Format: XML

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Source Name
- Ra (deg)
- Dec (deg)
- Flux (>100 MeV, avg. for the time interval of the catalog) (cm-2 s-1)
- Flux Uncertainty, 1 (cm-2 s-1)
- Photon spectral index (avg)
- Variability index
- Significance (avg)
- Significance (peak)
- Peak Flux (cm-2 s-1)
- Peak Flux uncertainty (cm-2 s-1)
- Candidate counterparts

Derived:

- Time Range (UT)

Browse Metadata:

Header Keyword:

- Source Name
- Ra (deg)
- Dec (deg)
- Flux (>100 MeV, avg. for the time interval of the catalog) (cm-2 s-1)
- Flux Uncertainty, 1 (cm-2 s-1)
- Photon spectral index (avg)
- Variability index
- Significance (avg)
- Significance (peak)
- Peak Flux (cm-2 s-1)
- Peak Flux uncertainty (cm-2 s-1)
- Candidate counterparts

Derived:

- Time Range (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.23 LS-010 -- Interstellar Emission Model

Contents: Model for diffuse gamma-ray emission from the Milky Way, input for high-level data analysis.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:
Header Keyword: TBD
Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.24 LS-003 -- LAT Low-Level Calibration

Contents: Calibration information for the subsystems, e.g., dead, off or noisy TKR strips, ACD tile status and PMT gains, CAL status and light sharing.

File Format: FITS

Validation Criteria: Checksum, datasum, file size, file version, fverify, file format, keywords (TBD)

GSSC Metadata:
Header Keyword: TBD

Derived:
- Time (UT)

Table: TBD

Browse Metadata:
Header Keyword: TBD
Derived:
- Time (UT)

Table: TBD

Custom Processing:

Software Release:

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.25 LS-006 -- LAT Configuration History

Contents: The configuration, and updates to the configuration, of the LAT. The configuration registers for the ACD, CAL, and TKR subsystems are occasionally read out and sent in their entirety (~800,000 values) in the telemetry stream for the LAT. To reduce the demand on the telemetry bandwidth, in the interim, only changes to the configuration (as a result of commands to the LAT) are sent so that the configuration at any given time can be reconstructed in detail.

File Format: TBD

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword: TBD
Derived:
- Time (UT)

Table: TBD

Browse Metadata:
Header Keyword: TBD
Derived:
- Time (UT)

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.26 Level 0 Data

Contents: Level 0 data from the instruments and the spacecraft, both science data and housekeeping.

File Format: Level 0

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:

Header Keyword:

- App ID
- Time

Table: TBD

Custom Processing:

Software Release: 1

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.27 MOC generated Anomaly Reports

Contents: Alert messages from the spacecraft or instruments.

File Format: ASCII

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:

Header Keyword:
- Time
- LAT/GBM/Spacecraft

Table: TBD

Custom Processing:

Software Release:

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.28 As-flown Timeline

Contents: As-flown timelines.

File Format: ASCII

Validation Criteria: Datasum, file size, file version, keywords (TBD)
GSSC Metadata:

Keyword:
- Week Number
- Time Range

Table: TBD

Browse Metadata:

Keyword:
- Week Number
- Time Range

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.29 SS-002 -- Photon Summary Data

Contents: Photons extracted from Event Summary Data.

File Format: FITS

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Number of events
- Detector
- Date-Obs
- Date-End
- Tstart
- Tstop

Column:

- Calib version

Table: TBD

Browse Metadata:

Header Keyword:

- Number of events
- Detector
- Date-Obs
- Date-End
- Tstart
- Tstop

Column:

- Calib version

Table: TBD

Custom Processing:

- Split files using HTM indexing

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name, version of GSSC software, name of the parent file.

Generated Products:

4.5.30 SS-001 -- Pulsar Ephemerides

Contents: Ephemerides of pulsars that may be GLAST-detectable.

File Format: FITS

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:

Keyword:

- Pulsar name
- Ra (J2000) (deg)
- Dec (J2000) (deg)
- Start of interval of validity for timing info (MJD) (days)
- End of interval of validity (MJD) (days)
- Infinite-frequency geocentric UTC arrival time of a pulse (MJD) (days)
- Pulsar rotation frequency (Hz)
- First derivative of pulsar frequency (Hz2)
- Second derivative of pulsar frequency (Hz3)
- Root-mean-square radio timing residual (periods)
- Source of timing information
- Flag for binary pulsars

Orbital Parameters for Binary Pulsars:

- Pulsar name
- Orbital period (s)
- Projected semi-major axis (s – light travel time)
- Orbital electricity
- Barycentric time (TDB scale) of periastron (MJD) (days)
- Longitude of periastron (deg)
- First derivative of longitude of periastron (deg per Julian year)
- Time-dilation and gravitational redshift parameter (s)
- First derivative of orbital period
- Source of orbital parameters

Table: TBD

Browse Metadata:

Keyword:

- Pulsar name
- Ra (J2000) (deg)
- Dec (J2000) (deg)
- Start of interval of validity for timing info (MJD) (days)
- End of interval of validity (MJD) (days)
- Infinite-frequency geocentric UTC arrival time of a pulse (MJD) (days)
- Pulsar rotation frequency (Hz)
- First derivative of pulsar frequency (Hz2)
- Second derivative of pulsar frequency (Hz3)
- Root-mean-square radio timing residual (periods)

- Source of timing information
- Flag for binary pulsars

Orbital Parameters for Binary Pulsars:

- Pulsar name
- Orbital period (s)
- Projected semi-major axis (s – light travel time)
- Orbital electricity
- Barycentric time (TDB scale) of periastron (MJD) (days)
- Longitude of periastron (deg)
- First derivative of longitude of periastron (deg per Julian year)
- Time-dilation and gravitational redshift parameter (s)
- First derivative of orbital period
- Source of orbital parameters

Table: TBD

Custom Processing:

Software Release: 4

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.31 LAT Instrument Commands

Contents: All commands to be uploaded within the weekly ATS submitted by the ISOC to the MOC through the GSSC, whether or not they were executed.

File Format: XML/Binary

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Command Mnemonic
- Priority

Table: TBD

Custom Processing:

Software Release: 2

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.32 LAT Instrument Memory Loads

Contents: All commands submitted by the ISOC to the MOC through the GSSC, whether or not they were executed.

File Format: XML/Binary

Validation Criteria: Datasum, file size, file version, keywords (TBD)
GSSC Metadata:
Header Keyword:
- Type of memory info
- Priority

Table: TBD

Custom Processing:

Software Release: 2

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.33 LAT Flight Software Loads

Contents: All FSW loads submitted by the ISOC to the MOC through the GSSC.

File Format: XML/Binary

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword:
- Reason for update
- Priority

Table: TBD

Custom Processing:

Software Release: 2

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.34 LAT SAA Definition Updates

Contents: An update to the LAT's definition of the SAA. Differs from the standard LAT memory load in that the spacecraft FSW uses the SAA definition. The GSSC will use the SAA definition in the science planning.

File Format: XML

Validation Criteria: Datasum, file size, file version, keywords (TBD)
GSSC Metadata:
Header Keyword:
- Version Number
- Date

Table: TBD

Custom Processing:

Software Release: 2

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.35 GBM Instrument Commands

Contents: All commands to be uploaded within the weekly ATS submitted by the GIOC to the MOC through the GSSC, whether or not they were executed.

File Format: XML/Binary

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword:
- Command Mnemonic
- Priority

Table: TBD

Custom Processing:

Software Release: 2

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.36 GBM Instrument Memory Loads

Contents: All commands submitted by the GIOC to the MOC through the GSSC, whether or not they were executed.

File Format: XML/Binary

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Type of memory info
- Priority

Table: TBD

Custom Processing:

Software Release: 2

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.37 GBM Flight Software Loads

Contents: All FSW loads submitted by the GIOC to the MOC through the GSSC.

File Format: XML

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:

Header Keyword:

- Reason for update
- Priority

Table: TBD

Custom Processing:

Software Release: 2

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.38 GBM SAA Definition Updates

Contents: An update to the GBM's definition of the SAA. Differs from the standard GBM memory load in that the SAA definition is used by the spacecraft FSW.
Validation Criteria: Datasum, file size, file version, keywords (TBD)

File Format: XML

GSSC Metadata:

Header Keyword:

- Version Number
- Date

Table: TBD

Custom Processing:

Software Release: 2

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.39 SS-004 -- GCN Notices

Contents: GLAST-produced GCN notices. These are captured from the GCN.

File Format: ASCII

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword:
- Burst Name
- Instrument (LAT/GBM)

Table: TBD

Browse Metadata:
Header Keyword:
- Burst Name
- Instrument (LAT/GBM)

Table: TBD

Custom Processing:

Software Release:
Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.40 SS-005 -- GCN Circulars

Contents: GLAST-produced GCN circulars. These are captured from the GCN.

File Format: ASCII

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword:
- Burst Name
- Instrument (LAT/GBM)

Table: TBD

Browse Metadata:
Header Keyword:
- Burst Name
- Instrument (LAT/GBM)

Table: TBD

Custom Processing:

Software Release:

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.41 Accepted GI Proposal Database

Contents: Abstracts of the accepted GI proposals.

File Format: ASCII

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:

Keyword:

- Object Name OR (RA,DEC)
- Specific object name
- GI name
- Proposal type
- Detector
- Proposal exposure time
- Reference to scientific justification text
- Reference to abstract
- TOO request flag

Table: TBD

Browse Metadata:

Keyword:

- Object Name OR (RA,DEC)
- Ra
- Dec
- Specific object name
- GI name
- Proposal type
- Detector
- Proposal exposure time
- Reference to scientific justification text
- Reference to abstract
- TOO request flag

Table: TBD

Custom Processing:

Software Release: 3

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.42 Integrated Observatory Timeline

Contents: Timeline of the commands and observing plan for the weekly ATS upload.

File Format: TBD

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword:
- Week Number
- Version

Table: TBD

Browse Metadata:
Header Keyword:
- Week Number
- Version

Table: TBD
Custom Processing:

Software Release: 3

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.43 MOC Supplied TDRSS Ephemerides

Contents: TDRSS ephemerides from Flight Dynamics.

File Format: FITS

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword:
- Start Date and Time

Table: TBD

Browse Metadata:
Header Keyword:
- Start Date and Time

Table: TBD

Custom Processing:

Software Release: 3

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.44 GLAST Ephemeris

Contents: GLAST's STK-generated ephemeris for the coming month; used for scheduling observations.

File Format: TBD

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword:
- Start Date and Time

Table: TBD

Browse Metadata:
Header Keyword:
- Start Date and Time

Table: TBD

Custom Processing:

Software Release: 3

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.45 Notifications, Acknowledgements and Dispositions

Contents: TBD.

File Format: ASCII

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword: TBD
Table: TBD

Browse Metadata:
Header Keyword: TBD
Table: TBD

Custom Processing:

Software Release: 3

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.46 Requested TDRSS Contact Schedule

Contents: The request for TDRSS contacts (time, TDRSS to be used) made by the MOC ~a month beforehand.

File Format: ASCII

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword: TBD
Table: TBD

Browse Metadata:
Header Keyword: TBD

Table: TBD

Custom Processing:

Software Release: 3

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

4.5.47 TDRSS Forecast Schedule

Contents: The granted TDRSS contacts (time, TDRSS to be used). Required by the GSSC for creating the final science activity schedule.

File Format: ASCII

Validation Criteria: Datasum, file size, file version, keywords (TBD)

GSSC Metadata:
Header Keyword: TBD
Table: TBD

Browse Metadata:
Header Keyword: TBD
Table: TBD

Custom Processing:

Software Release: 3

Log Information: Filename, version number, archival date and time, delivery dates and times, database name.

Generated Products:

5 GSSC Computer System

The GSSC computer system is designed to reliably ingest data from the IOC's, process and archive the data, and make the data products available to the general user community on a short timescale. The GSSC hardware will consist of PC's networked together and running the Linux operating system. The GSSC computer system will be isolated from the web behind a firewall run by LHEA (Laboratory for High Energy Astrophysics) and will communicate to the outside entities (the MOC and IOC's) using secure protocols. Figure 5-1 shows the GSSC computers for data ingest data processing, creation and maintenance of the data products along with their metadata, and software development as blue boxes.

The web interface will be the primary public access to the GLAST data products. . The GSSC web pages will be hosted by the HEASARC and will be served off HEASARC servers using their security protocol. The web interface will retrieve data from the photon and event databases (located on dedicated machines) and GSSC data products from the S/C (Spacecraft) data server. The burst data, spacecraft data, timelines, etc. will be served off the S/C data server. The size and nature of these data products are such that the standard HEASARC system (metadata and archive files) will be used to access these data. The time to access these products will be a few seconds at most. The main photon and event databases will be accessed through two Linux clusters. These Linux clusters are selected so that the data can be searched in a reasonable amount of time (the requirement is 10 min; our goal is less than one minute) so that the data can be acquired in near real time. To achieve this goal the Linux clusters will read the FITS files containing the data while distributing the request among its nodes. This allows the primary data to remain in HEASARC compatible FITS format while reducing the time to finish any one data request.

The GSSC development system will provide a common infrastructure for software development and testing. One machine will provide a platform for development and testing of the GSSC pipeline, the MySQL database, metadata, and GSSC developed science tools. In addition it will be the software license server, Roundup and Doxygen platform, store test data, and generate software builds. An additional computer will be used for software system tests and will isolate any problems from the general development environment.

We plan to develop the GSSC hardware in concert with the support for the ground tests and software development. Table 5-1 shows the schedule for acquiring the hardware and the ground test or software release that is supports. We will procure the hardware in four phases. Phase 1 is to procure the basic system that will be used for support of the initial ground tests and software release. This will also provide a platform for timing tests of the various software. The hardware for phase 2 is to support the initial development of the timeline and command passing for the ground tests. The phase 3 hardware is to

support the GSSC in system tests for the software releases 3-5. The hardware for Phase 4 is to bring the GSSC computer system to the state to support activities after launch. The timing of hardware acquisitions gives adequate time for testing the system before support in needed for each of the supported activities.

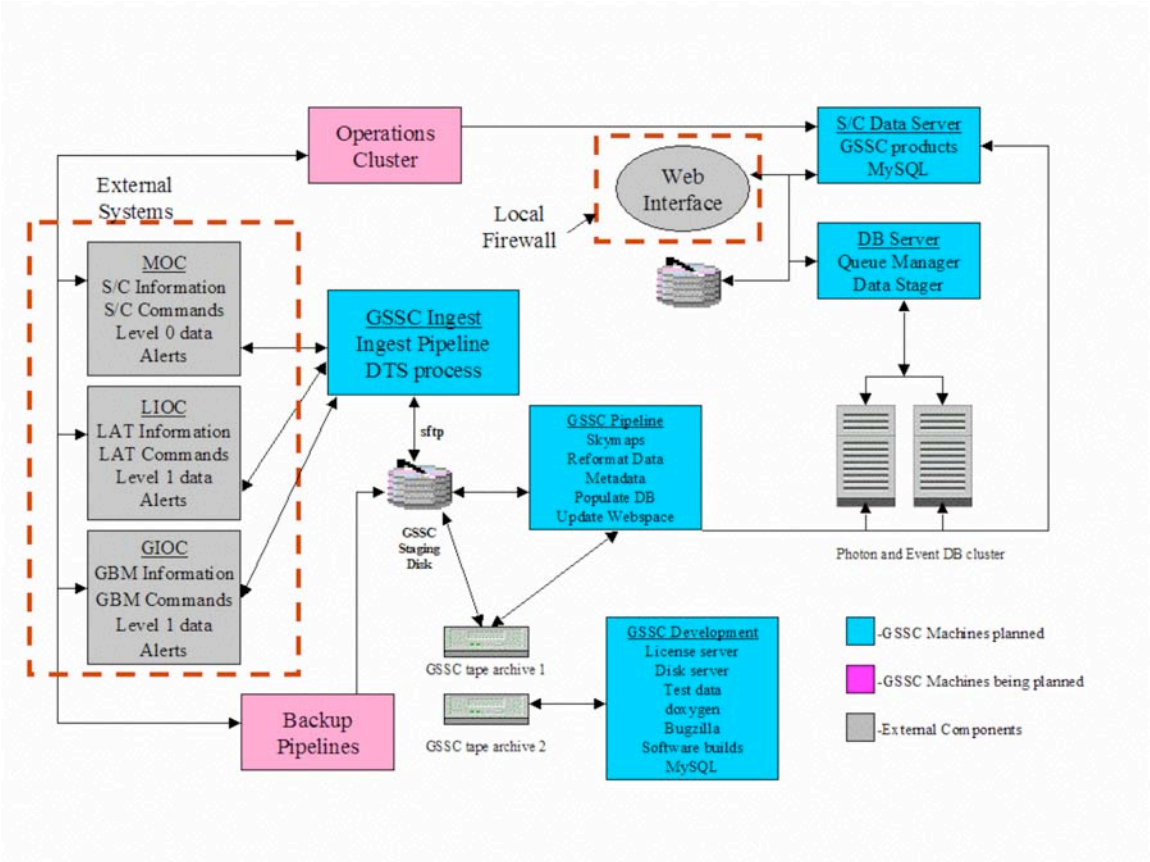

Figure 5-1 The GSSC computer system hardware configuration.

Hardware Phase	Hardware	Support	Additional Capabilities	Status
Phase 1 3/1/04 L-30 months	Linux Cluster #1 Development computer	GRT-1 S/W Release 1	Data transfer DB creation Data Ingest (L0)	Testing/ Ordered
Phase 2 1/15/05 L-20.5 months	Operations Computer	GRT-2 S/W Release 2	Preliminary Timeline planning Command transfer	TBD
Phase 3 6/15/05 L-15.5 months	Systems Tests Computer	S/W Release 3 GRT-4 GRT-5 S/W Release 4	System Tests	TBD
Phase 4 3/1/06 L-6 months	Linux Cluster #2 DB Server Ingest computer Pipeline computer S/C Data server	NRA Release S/W Release 5	Proposal Ingest	TBD

Table 5-1: Hardware acquisition schedule.

6 Operations Software

ID	Name	Description	Release
Op10	As-Flown Timeline Ingest	Ingests the as-flown timeline from the MOC, archives it, and compares it to the final science timeline for the same period	4
Op20	Integrated Observatory Timeline Ingest	Ingests the integrated observatory timeline from the MOC and archives it	3
Op30	Anomaly Reports Ingest	Ingests the anomaly reports from the MOC and archives them. These reports pertain to the spacecraft and both instruments	5
Op40	GLAST Ephemeris Ingest	Ingests from the MOC the GLAST STK-generated ephemeris for the coming month, archives it, and makes it available to the scheduling tool	2
Op45	TDRSS Ephemeris Ingest	Ingests from the MOC TDRSS ephemerides and makes them available to the scheduling tool.	2
Op50	TDRSS Contact Schedule Ingest	Ingests from the MOC the schedule of requested or actual TDRSS contacts, archives it, and makes it available to the scheduling tool	3
Op60	Observatory Telemetry and Command Database Ingest	Ingests from the MOC updates to the database that defines telecommands, telemetry, discretes, analogs, limits, flight parameter mnemonics and ground system parameters. The database is archived. This database may be ITAR-controlled.	2
Op70	Command Ingest	Ingests from the ISOC or the GIOC commands or memory loads to be uploaded to the spacecraft. The commands are archived, and made available to the scheduling tool.	2
Op80	Command Submit	Submits commands to the MOC	
Op90	Planning Tool	Assists the design of observing strategies for optimum sky coverage.	4
Op100	Scheduling Tool	Generates the preliminary and final science timelines.	2
Op110	Science Timeline Submit	Submits the preliminary and final science timelines to the MOC.	2
Op120	TOO Orderer	Creates and submits to the MOC TOO orders.	5
Op140	Pager Tool	Alerts GSSC staff if urgent action is required (e.g., commands from IOC).	5
Op150	TOO Evaluator	Assists Duty Scientist in evaluating feasibility of a requested TOO observation.	5
Op160	Proposal Ingestor	Interface between Proposal Submission tools and Scheduling tool.	4
Op170	ST2FT2	Converts Science Timeline format file to FT2 format. Used in sky coverage monitor.	

6.1 Op10 As-Flown Timeline Ingest

Purpose:
Ingests the as-flown timeline from the MOC, archives it, and compares it to the final science timeline for the same period

FRD Requirements Satisfied: 5.4.1.4.14

Interface:
Initiated by receipt of notice from file transfer system of the as-flown timeline's arrival, logs posted to internal website

Input:
As-flown timeline
Notice that timeline has arrived
Final science timeline

Output:
d. As-flown timeline archived
e. Report of comparison of as-flown timeline and planned observing timeline posted on internal GSSC website

Description:
The as-flown timeline describes the observations that actually occurred. The MOC sends this file to the GSSC once a week, and the GSSC must ingest it into its databases. In addition, this timeline is compared to the planned timeline, identifying the TOOs and ARs that disrupted the planned timeline and the resulting loss of GI-requested exposure.

The process manager will monitor for the receipt of this file and issue an alert via the Pager Tool if the as-flown timeline is not received.

The operations are:
1. The tool is activated by receipt of a notice from the file transfer system that a timeline has arrived.
2. The tool archives the timeline
3. The tool compares the as-flown and planned timelines
4. GSSC duty scientist is informed

Candidate: Custom software.

Ops Software Release: 4

Testing:
5. Tests:
    1. Tool activated by notice that as-flown timeline has arrived

2.As-flown timeline archived properly
3.Duty scientist informed
4.Comparison of as-flown and science timelines, same observations
5.Comparison of as-flown and science timelines, different observations
6.Graceful handling of corrupted files

6.Files:

1.Sample as-flown timeline
2.Sample final science timeline with same timeline as as-flown timeline
3.Sample final science timeline with different timeline as as-flown timeline
4.Corrupted as-flown timeline

6.2 Op20 Integrated Observatory Timeline Ingest

Purpose:
Ingests the integrated observatory timeline from the MOC and archives it

FRD Requirements Satisfied: 5.4.1.4.12

Interface:
Initiated by receipt of notice from file transfer system of the integrated observatory timeline's arrival, logs posted to internal website

Input:
Notice from file transfer system that timeline has arrived
Integrated observatory timeline

Output:
Timeline archived

Description:
The integrated observatory timeline incorporates the science timeline sent to the MOC by the GSSC and the spacecraft commands added by the MOC; the timeline covers a period of one week. This tool ingests the timeline into a GSSC database.
The process manager will monitor for the receipt of this file and issue an alert via the Pager Tool if the as-flown timeline is not received.

The operations are:

1. The tool is activated by receipt of a notice from the file transfer system that a timeline has arrived.
2. The tool archives the timeline
3. GSSC duty scientist is informed

Candidate: Custom software; interfaces with file transfer software.

Ops Software Release: 3

Testing:

7. Tests:
    - 7.1. Tool activated by notice that timeline has arrived
    - 7.2. Timeline archived properly
    - 7.3. Duty scientist informed
    - 7.4. Graceful handling of corrupted files
8. Files:
    - 8.1. Sample Integrated Observatory Timeline
    - 8.2. Corrupted file

6.3 Op30 Anomaly Reports Ingest

Purpose:
Ingests the anomaly reports from the MOC and archives them. These reports pertain to the spacecraft and both instruments.

FRD Requirements Satisfied:

Interface:
Initiated by receipt of notice from file transfer system of the anomaly report's arrival, logs posted to internal website

Input:
Notice from file transfer system that report has arrived
Anomaly report

Output:
GSSC duty scientist informed.
Anomaly report archived

Description:
The GSSC receives anomaly reports generated by the GLAST observatory and archives them as a record of the mission's history. In general the GSSC does not have to react to these reports, but as part of the mission will want to monitor them.
The operations are:

1. The tool is activated by receipt of a notice from the file transfer system that a report has arrived.
2. The tool archives the report
3. GSSC duty scientist is informed

Candidate: Custom software; interfaces with file transfer software.

Ops Software Release: 5

Testing:

1. Tests:
    a. Tool activated by notice that report has arrived
    b. Report archived properly
    c. Duty scientist informed
    d. Graceful handling of corrupted files
2. Files:
    a. Sample anomaly report
    b. Corrupted file

6.4 Op40 GLAST Ephemeris Ingest

Purpose:
Ingests from the MOC the GLAST STK-generated ephemeris, archives it and makes it available to the scheduling tool.

FRD Requirements Satisfied: 5.4.1.4.13

Interface:
Initiated by receipt of notice from file transfer system of the ephemeris' arrival, logs posted to internal website

Input:
Notice from file transfer system that ephemeris has arrived
GLAST Ephemeris

Output:
GSSC duty scientist informed
Ephemeris archived
Orbit prediction updated

Description:
The creation of the science timeline by the scheduling tool requires a prediction of GLAST's orbit. The MOC will provide these predictions for a given week beginning ~a month beforehand, and will update the prediction weekly.

i)The tool is activated by receipt of a notice from the file transfer system that an ephemeris has arrived.
ii)The tool archives the ephemeris.
iii)The tool updates the ephemeris used by the scheduling tool
iv)GSSC duty scientist is informed

Candidate: Custom software; interfaces with file transfer software.

Ops Software Release: Included in 2, ready by 3

Testing:

1 Tests:
- 1.1 Tool activated by notice that ephemeris has arrived
- 1.2 Ephemeris archived properly
- 1.3 Ephemeris used by scheduling tool updated
- 1.4 Duty scientist informed
- 1.5 Graceful handling of corrupted files

2 Files:
- 2.1 Sample GLAST ephemeris
- 2.2 Corrupted file

6.5 Op45 TDRSS Ephemeris Ingest

Purpose:
Ingests from the MOC the TDRSS ephemerides, archives them and makes them available to the scheduling tool.

FRD Requirements Satisfied: 5.4.1.4.13

Interface:
Initiated by receipt of notice from file transfer system of the ephemeris' arrival, logs posted to internal website

Input:
Notice from file transfer system that ephemeris has arrived
TDRSS Ephemerides

Output:
GSSC duty scientist informed
Ephemerides archived
Orbit prediction updated

Description:
It is possible that special pointings may be required to enable TDRSS contacts at particular times. In order to design these pointings a knowledge of the TDRSS locations is required.

v) The tool is activated by receipt of a notice from the file transfer system that ephemerides have arrived.
vi) The tool archives the ephemerides.
vii) The tool updates the ephemerides used by the scheduling tool
viii) GSSC duty scientist is informed

Candidate: Custom software; interfaces with file transfer software.

Ops Software Release: Included in 2, ready by 3

Testing:

3 Tests:
- 3.1 Tool activated by notice that ephemeris has arrived
- 3.2 Ephemerides archived properly
- 3.3 Ephemerides used by scheduling tool updated
- 3.4 Duty scientist informed
- 3.5 Graceful handling of corrupted files

4 Files:
- 4.1 Sample TDRSS ephemeris
- 4.2 Corrupted file

6.6 Op50 TDRSS Contact Schedule Ingest

Purpose:
Ingests from the MOC the schedule of requested or actual TDRSS contacts, archives it and makes it available to the scheduling tool.

FRD Requirements Satisfied: 5.4.1.4.10, 5.4.1.4.11

Interface:
Initiated by receipt of notice from file transfer system of the schedule's arrival, logs posted to internal website

Input:
Notice from file transfer system that schedule has arrived
Requested TDRSS Contact Schedule

Output:
GSSC duty scientist informed
Requested TDRSS Contact Schedule archived
Scheduling tool provided TDRSS constraints

Description:
The creation of the final science timeline by the scheduling tool will be constrained by the TDRSS contacts. The MOC will provide the schedule of first the requested and then the actual TDRSS contacts; the GSSC may revise the preliminary science timeline as long as these contacts can be maintained.
The process manager will monitor and alert in the TDRSS schedule is not received.

1. The tool is activated by receipt of a notice from the file transfer system that a schedule has arrived.
2. The tool archives the schedule.
3. The tool updates the TDRSS contact schedule used by the scheduling tool
4. GSSC duty scientist is informed

Candidate: Custom software; interfaces with file transfer software.

Ops Software Release: 3

Testing:

1. Tests:
    a. Tool activated by notice that TDRSS schedule has arrived
    b. TDRSS schedule archived properly
    c. TDRSS schedule used by scheduling tool updated
    d. Duty scientist informed
    e. Graceful handling of corrupted files
2. Files:

a. Sample requested TDRSS contact schedule
b. Sample actual TDRSS contact schedule
c. Corrupted file

6.7 Op60 Observatory Telemetry and Command Database Ingest

Purpose:
Ingests from the MOC updates to the database that defines telecommands, telemetry, discretes, analogs, limits, flight parameter mnemonics and ground system parameters. The database is archived. This database may be ITAR-controlled.

FRD Requirements Satisfied:

Interface:
Initiated by receipt of notice from file transfer system of the database's arrival, logs posted to internal website

Input:
Notice from file transfer system that database has arrived

Output:
Database is archived

Description:
The Observatory Telemetry and Command Database defines the commands and procedures that will be used to control the spacecraft and the instruments. Currently the GSSC is not planning to use this database to interpret the commands from the IOCs, but the commands used for describing observations will be in the database.

Candidate: Custom software; interfaces with file transfer software.

Ops Software Release: 2

Testing:
1. Tests:
    a. Tool activated by notice that database has arrived
    b. Database archived properly
    c. Duty scientist informed
    d. Graceful handling of corrupted files
2. Files:
    a. Sample database
    b. Corrupted file

6.8 Op70 Command Ingest

Purpose:
Ingests commands or memory loads from the ISOC or GIOC. Archives these commands and makes them available to the scheduling tool.

FRD Requirements Satisfied: 5.4.1.6

Interface:
Initiated by receipt of notice from file transfer system of the commands' arrival, logs posted to internal website

Input:
Commands or memory load from IOC, with a wrapper describing the command
Notice from file transfer system that command has arrived

Output:
Commands archived (always)
Commands sent to command submit tool (if high priority)
Notice placed in scheduling 'to do list' (if commands are for weekly ATS load)
Notice to GSSC duty scientist (if commands implemented independent of ATS load)

Description:
This tool implements the GSSC's processing of commands from the IOCs:

1. The tool is activated by receipt of a notice from the file transfer system that a command has arrived.
2. The tool archives the command.
3. The tool parses the wrapper:
    1. If the command has a high priority flag (indicating the command must be uplinked immediately) then the command is passed to the command submit tool for immediate transfer to the MOC.
    2. If the command is to be included in the weekly ATS load, then a message is placed in the scheduling 'to do list.' The command will be merged into the science timeline when the GSSC constructs the timeline.
    3. If the commands are to be uplinked separately, then the GSSC duty scientist will be informed. The duty scientist will send them on to the MOC with implementation instructions using the command submit tool.

Candidate: Custom software; interfaces with file transfer software.

Ops Software Release: 2

Testing:

1. Tests:
    a. Tool activated by notice that command has arrived

   b. Command archived properly
   c. High priority command submitted immediately to command submit tool
   d. Message placed in scheduling ‘to do list’ for ATS command
   e. Duty scientist informed for non-ATS command
   f. Graceful handling of corrupted files
2. Files:
   a. Sample real time command with high priority flag
   b. Sample command for
   c. Corrupted files

6.9 Op80 Command Submit

Purpose:
Submits commands and memory loads to the MOC. These are commands that are not part of the weekly ATS loads.

FRD Requirements Satisfied: 5.4.1.6.2, 5.4.1.6.3, 5.4.1.6.5

Interface:
Initiated by the command ingest tool (for high priority commands) or from the command line (for commands independent of weekly ATS load).

Input:
Commands or memory loads, with a wrapper describing the command

Output:
Commands archived (always)
Commands sent to MOC

Description:
This tool submits commands to the MOC.

Candidate: Custom software; interfaces with file transfer software.

Ops Software Release:

Testing:

1. Tests:
    a. Tool activated by high priority command
    b. Tool activated from command line
    c. Commands archived properly
    d. Command submitted to file transfer system correctly
    e. Graceful handling of corrupted files
2. Files:
    a. Sample command
    b. Corrupted file

6.10 Op90 Planning Tool

Purpose:
To "design" schedules for optimum sky coverage. Investigate different scan patterns, compensation for SAA reduction in sky coverage, enhance coverage of any particularly interesting sky regions.

FRD Requirements Satisfied: 5.4.1.1.1

Interface:
Command Line

Input:
ASCII file

Output:
ASCII file with RA, DEC
FT2 file

Description: This tool calculates GLAST's orbit and the LAT's orientation. Therefore, the tool must implement the same observing modes as the spacecraft. The resulting history of where the LAT was pointing can then be studied for the efficacy of different observation strategies.

Candidate: Davis/Stoneking simulator with any required changes.

Ops Software Release: 4

6.11 Op100 Scheduling Tool

Purpose: Generation of observation schedule.

FRD Requirements Satisfied: 5.4.1.1.2, 5.4.1.4.4, 5.4.1.4.5, 5.4.1.4.6, 5.4.1.4.7, 5.4.1.4.8, 5.4.1.4.9, 5.4.1.5.2

Interface: GUI

Input:
GLAST orbital parameters.
TDRSS orbital parameters.
Proposal information (** from Web tool).
IOC products received via Op60 and Op70 that are to be included in the Science Timeline rather than loaded by the MOC.

Output:
Science Timeline in format specified by the ICD.

Description:
May contain survey observations and/or pointed observations. Surveys can potentially contain a variety of scan patterns either executed as spacecraft RTS or with each individual maneuver specified.

Candidate: TAKO. (Other candidates would be Spike and STK tools).

Ops Software Release: 2 (in preliminary form), 3 in near final form

6.12 Op110 Science Timeline Submit

Purpose:
Delivers the preliminary and final science timelines to the MOC. The submitted timeline is archived.

FRD Requirements Satisfied: 5.4.1.4.5, 5.4.1.4.6

Interface:
Command line tool

Input:
Science timeline produced by scheduling tool (format TBD)

Output:
a. Science timeline file sent to MOC (format TBD)
b. Science timeline archived in database

Description:
The GSSC generates a preliminary science timeline 3+ weeks before the timeline is implemented, and a final science timeline a few days before implementation. This tool sends the timeline, and logs this transmission.

Candidate: File transfer software and custom scripts

Ops Software Release: 2

Testing:
1. Tests:
    a. Tool activated from command line
    b. Timeline archived properly
    c. Timeline submitted to file transfer system correctly
    d. Graceful handling of corrupted files
2. Files:
    a. Sample preliminary science timeline
    b. Sample final science timeline
    c. Corrupted file

6.13 Op120 TOO Orderer

Purpose:
Generates the TOO order and sends it to the MOC

FRD Requirements Satisfied: 5.4.1.5.3, 5.4.1.5.5

Interface:
Command line interface as minimum. Web page or other graphical interface may also be desired.

Input:
a. Position of the source.
b. Start and end times of the observation.
c. Name of person executing TOO order.

Output:
a. File with TOO order in format specified by the ICD sent to the MOC
b. GSSC personnel are notified that the TOO order has been sent, possibly via the paging system.
c. Archives the TOO order along with time TOO order was sent.

Description:
The GSSC Duty Scientist will use this tool to create and send TOO orders after the Project Scientist approves the TOO. The TOO order is logged. (For TOO requests that cannot be accommodated in the regular Science Timeline).

Candidate:
Custom software + file transfer software

Ops Software Release: 5

Testing:
1. Tests:
    a. Tool activated from command line
    b. Correct order generated
    c. Order submitted to file transfer system correctly
    d. Order archived successfully
    e. Duty scientist informed
    f. Graceful handling of incorrect inputs
2. Files—none

6.14 Op140 Pager Tool

Purpose:
Alert relevant GSSC personnel and Project Scientist of urgent actions required (e.g., command load from IOC, TOO request)

FRD Requirements Satisfied:

Interface: Initiated by software or by command line interface.

Input:
a. Software request that designated people be paged
b. List of who should be paged for given conditions
c. Command line interface to acknowledge receipt of page, track pages, place pages on hold etc.

Output:
Page.
Update of page database.

Description:
In certain circumstances (TOO request, receipt of IOC commands, alerts) various GSSC staff and the Project Scientist need to be notified. The Pager Tool will be able to generate the following types of alerts:

e-mail only alerts
pager only alerts
both e-mail and pager alerts.

A "page" refers to an instant method of sending alerts to traditional pagers, cell phones, and/or PDAs.
The software will support flexible escalation schemes. If the initial page is not responded to within a specified period of time then alert is "escalated" and sent to a larger specified list. The escalation schemes must have multiple layers and be configurable for each different possible type of page.
The pager tool must be able to track alerts from initiation to successful conclusion.

Candidate:
Reuse of XTE system. This is a combination of commercial (*TelAlert*) and homegrown software and has at least as much capability as required.

Ops Software Release: 5

6.15 Op150 TOO Evaluator

Purpose:
A tool that is simpler to run than the Scheduling Tool (Op100) that can be used by the Duty Scientist to evaluate the feasibility of a proposed TOO observation.

FRD Requirements Satisfied:

Interface: Command line and/or web or other GUI.

Input:

Coordinates of proposed target.

d. Period of time of interest.
e. GLAST and TDRSS ephemerides.
f. Possibly also current Science Timeline.

Output:
Efficiency of observations of proposed target as a function of time. Optionally graphically displayed.

Description:
This tool assists the Duty Scientist in evaluating the efficiency of proposed TOO observations taking into account relative phasing of SAA passages and Earth occultations of a target. It is a "light weight" program compared to the main scheduling tool

Candidate:

The suitability of target tool developed for RXTE.
Ops Software Release: 5

6.16 Op160 Proposal Ingestor

Purpose:
Takes data from W-09 and W-10 proposal submission tools and makes available to the Scheduling Tool (Op100).

FRD Requirements Satisfied:

Interface: Automatically runs when proposals are submitted.

Input:
Output from proposal submission tools.

Output:
Database updates.

Description:

Candidate:
Custom software.

Ops Software Release: 4

6.17 Op160 Proposal Ingestor

Purpose:
Converts a file in Science Timeline format as produced by the scheduling tool and converts it to FT2 format.

FRD Requirements Satisfied:

Interface: Automatically runs when Science Timeline is generated.

Input:
Output from scheduling tool.

Output:
Database updates.

Description:

Candidate:
Custom software.

Ops Software Release: 4

7 User Support Tools

This subsystem consists of most of the tools at the interface with the user community. The GSSC requires tools that post information for this community on the GSSC website. Since the GSSC will run the guest investigator (GI) program, the GSSC will provide the GI community with tools that will assist in the preparation of observation proposals. Of course, tools useful for simulating a proposed observation can also assist a user determine the significance of a putative detection.

Where possible we use existing tools, both for efficiency and because the user community will be familiar with these tools. In the following table are listed the tools. Not listed are the interfaces to certain key databases (e.g., D1, the LAT photon and event databases) since the architecture of these databases is intimately tied to the access interface (usually BROWSE-like). In some cases the listed tool was/will be developed in another context (e.g., the Standard Analysis Environment), but is included here for completeness.

ID	Name	Description	GSSC Release
S-01	Source Sensitivity Calculator	This tool allows a user to estimate the detectability of a source, its variability, etc. It consists of a number of sub-tools: • Source Name Resolver—using NED and SIMBAD • Background Estimator—estimates the background flux from the diffuse Galactic and extra-galactic emission from a given point or region on the sky. • Exposure Calculator—the rate at which exposure is accumulated (e.g., cm^2-s per day) • γPIMMS—the expected count rate for a given source and a given mission; input may be the source parameters from another mission. • Sensitivity Calculator—calculates the time for a source detection, for significant variability, etc.	6
S-02	Exposure Analyzer	Reads in pointing history (FT2) and plots exposure map and history. Can be used to evaluate past, future and proposed observations	7
S-03	Orbit Simulator	Simulates an orbit with an observation plan	6
S-04	Observation Simulator	Simulates an observation of a given region	SAE

S-05	LAT Simulated Spectral Analysis A	Simulates the 1D spectral analysis of a LAT source.	SAE
S-06	LAT Simulated Spectral Analysis B	Simulates the 3D (spectral+spatial) analysis of a LAT source.	SAE
S-07	GBM Simulated Spectral Analysis	Simulates the spectral analysis of a burst observed by the GBM.	SAE
S-11	Weekly Timeline Display	Posts the weekly science timelines	7
S-12	Annual Timeline Display	Posts the annual science timeline	7
S-13	As-Flown Timeline Display	Posts the as-flown timeline	7
S-21	GI Proposal Submission Interface	Web interface for the submission of essential data regarding GI proposals	6
S-31	ToO Proposal Submission Interface	Web interface for the submission of ToO proposals	5
S-32	Approved ToO Display	Posts information about an approved ToO observation	7
S-41	LAT Observation Request Interface	Interface for the LAT team to request calibration observations	6
S-51	Count Map Generator	Generates count maps. The tool will be run periodically by a software pipeline.	7
S-52	Exposure Map Generator	Plots the exposure map for the entire sky and select regions. The tool will be run periodically by a software pipeline.	7
S-53	LAT Diffuse Emission Display	Displays the current diffuse emission model	6
S-54	GRB Map Display	Creates and displays map of GRB locations	7

S-55	GRB Lightcurve Display	Displays a lightcurve for each GRB	7
S-56	GCN Post	Receives, archives and posts on a webpage GLAST GCN Notices and Circulars.	3
S-57	Point source monitor	Monitors a list of point sources	NA
S-61	Help Desk Question Submission	Enables users to submit questions about GLAST analysis to the GSSC via a webform.	6
S-62	Help Desk Response Administration	Transfers the questions submitted via the GSSC helpdesk (S-61) to duty scientists responsible for answering them, tracks the response time, archives subsequent correspondence.	6
S-63	FAQ Access	Enables the website user to browse and search the list of frequently asked questions compiled from the GSSC helpdesk submissions.	6

7.1 S-01 Source Sensitivity Calculation

This series of tools is designed to allow a user to estimate the detectability of a source or, if a source is known, its variability. Thus scientists can use this tool in preparing GI proposals, and the GSSC can evaluate the technical feasibility of submitted proposals with this tool.

The tool may be presented to the user through a website with a number of sections, reflecting the segmentation of the tool into a number of smaller tools. These segments are:

S-01a—Source Name Resolver: allows the user to input a source name rather than the spatial coordinates

S-01b—Background Estimator: estimates the background against which the source must be detected

S-01c—Exposure calculator: provides an approximation of how long (actual calendar time) a source must be observed in a number of different observing modes (e.g., survey, pointed) to achieve a required exposure. The underlying assumption is that observations over many orbits are required, allowing averages over the exposure per orbit and SAA passages. We will perform trade studies to determine the sensitivity to the orbital precession phase; if the sensitivity is large then the exposure accumulation rate may be given an orbital precession dependence.

S-01d—Count Rate Calculator (γPIMMS): estimates the flux of a source given the source's spectrum or it detection by another instrument (e.g., EGRET).

S-01e—Sensitivity Calculator: estimates the time to achieve a given source detection, etc. The underlying methodology will be based on the signal-to-noise-ratio, although the calculation will be complicated the issue of the size of the spatial region over which the signal and the noise should be accumulated. This will have to be resolved through simulations.

In every segment the user will be able to over ride the results of that segment, allowing the user to perform 'what if' experiments. Thus a user could change the background estimate if the source of interest is near a strong source that was not included in the background estimate.

FRD Requirements Satisfied: 5.3.2.1, 5.3.2.4

7.1.1 S-01a—Source Name Resolver

Purpose: This tool resolves source names into their spatial coordinates using NED and SIMBAD.

Interface: Webpage

Input:
1. Source name
2. Choice of catalog

Output:
Source position, RA and DEC (J2000)

Description:
Existing Perl scripts query NED and SIMBAD for source coordinates. The user must choose between these catalogs; the same source may have slightly different coordinates in each.

Candidate: Existing Perl scripts

Software Release: 6

Testing:
A series of known sources (e.g., 3C273, SS 433) will be input, and the returned coordinates will be checked. Similarly, some nonsensical names will be input to test the tool's response.

7.1.2 S-01b—Background Estimator

Purpose: This tool estimates the background flux from the diffuse Galactic and extra-galactic emission from a given point or region on the sky

Interface: Webpage

Input:

1. Sky position (may be input through S-01a—Source Name Resolver)
2. Radius (for a cone search) [arcmin]
3. Choice of background model (standard GLAST, EGRET?)

Output:

Normalization of the background flux, printed to the screen and available to other S-01 tools

Description:

Since the background is usually assumed to have the same spectra, the normalization suffices. The tool will provide the background either at a particular point or in a region around the point. The user will have a choice of different models.

Note: we will post maps of the standard models of the diffuse background for users to study the region of interest.

Candidate: Code from the SAE

Software Release: 6

Testing:

The output from the tool for a number of sky positions will be compared to plots of the background, or to values extracted by the SAE.

7.1.3 S-02c—Exposure Calculator

Purpose: This tool calculates the rate at which exposure is accumulated (e.g., cm^2-s per day) for a point on the sky. Trade studies will determine whether the exposure accumulation rate depends significantly on the orbit precession phase.

Interface: Webpage

Input:

Sky position (may be input through S-01a—Source Name Resolver); only the declination matters

Optional: orbit precession phase (?)

Output:

Exposure accumulation rate, printed to the screen and available to other S-01 tools. The exposure accumulation rate may be given for:

1. Standard observing modes
    a. Survey
    b. Pointed
2. Standard FOVs
    a. 55° opening angle
    b. 70° opening angle

Description: This tool will rely on tables of the exposure accumulation rate for standard observing modes, e.g., survey and pointed modes. The accumulation rate will be averaged over many orbits, and the exposure will be averaged over inclination angle for standard opening angles (e.g.,. 55° and 70°).

Candidate: None

Software Release: 6

Testing:

7.1.4 S-01d—Count Rate Calculator (γPIMMS)

Purpose: This tool calculates the expected count rate for a given source and a given mission. Input may be the source parameters from another mission.

FRD Requirements Satisfied: Note that this tool addresses 5.3.2.1.2

Interface: Webpage

Input:

1. Source parameters
    a. Analytic spectrum
        i. Power law
        ii. Line
    OR
    b. Flux from another mission (LAT, EGRET)
2. Output mission (e.g., LAT, EGRET)
3. Desired Output:

Output:
Count rate or flux for the selected output system

Description: This tool will use tables describing the various instruments with various assumed spectral forms (i.e., the spectra are folded through the instrument response functions, where necessary averaged over angle).

Candidate: PIMMS

Software Release: 6

Testing:

7.1.5 S-01e—Sensitivity Calculator

Purpose: This tool uses the background, the source count rate and the exposure accumulation rate to calculate the time for a source detection, for significant variability, etc.

Interface: Webpage

Input:
1. Background rate (may be from S-01a)
2. Exposure accumulation rate (may be from S-01b)
3. Source strength (may be from S-01c)

Output: Time for nσ source detection, Time for nσ variability detection

Description: This tool will use a signal-to-noise ratio approach to calculating the time necessary for a source detection, or if so desired, for the detection of the variability of a given magnitude. The size of the region over which the signal and the noise should be accumulated is of order a PSF radius, but simulations with Likelihood are needed.

Candidate: None

Software Release: 6

Testing:

7.2 S-02: Exposure Analyzer

Purpose: Reads in pointing/livetime history (FT2) and plots exposure map and history. Can be used to evaluate past, future and proposed observations

FRD Requirements Satisfied: 5.3.2.1, 5.6.4, 5.4.1.3, 5.6.4

Interface: Web

Input:

Pointing/livetime history (FT2)
Location
Time range
Region size
Maximum inclination angle

Output:

Sky exposure map
Time history plot

Description:

This tool is used to:

- Using past observations, a GSSC pipeline can create exposure maps to be posted on GSSC's website
- Using a proposed timeline, a GSSC timeline planner can evaluate a proposed science timeline; the scheduling tool must produce an FT2 file
- Using the scheduled timeline (a preliminary version is available a ~month in advance), a user can determine when and with how much exposure a source will be observed; the scheduling tool must produce an FT2 file
- Using a proposed observation (e.g., out of the O1=S-03 tool), a user can evaluate an observation scheme

The tool should pop up 2 plots: a sky exposure map centered on the chosen location, and a time history of the exposure at the chosen location.

Candidate: Related code exists in the SAE

Software Release: 7

Testing:

7.3 S-03: Orbit Simulator

Purpose: Simulates an orbit with an observation plan

FRD Requirements Satisfied: 5.3.2.1, 5.4.1.1.1

Interface: Web

Input:
See O1

Output:
Pointing/livetime history (FT2) file

Description:
This tool is the SAE's O1 with a web interface. This will permit users to try different observation strategies. The resulting FT2 file can then be fed into the 'Exposure Analyzer' S-03.

Candidate: O1 in the SAE

Software Release: 6

Testing:
This is the SAE's O1 tool with a web interface, and therefore the basic testing will be the responsibility of the SAE. Here we need only test whether the web interface is accessing O1 correctly. Therefore, a series of runs with and without the web interface should be compared to show the same results. The web interface should be exercised so that improperly formatted input is flagged.

7.4 S-04: Observation Simulator

Purpose: Simulates an observation of a given region

FRD Requirements Satisfied: 5.3.2.1, 5.3.2.4

Interface: User's server

Input:
See O2

Output:
See O2

Description:
This tool is the SAE's O2; the user will be expected to download and run the tool. With access to the simulation capabilities of the SAE the user can undertake a high fidelity simulation.

Candidate: O2 in the SAE

Software Release: Part of SAE

Testing:
As part of SAE

7.5 S-05: LAT Simulated Spectral Analysis A

Purpose: Simulates the 1D spectral analysis of a LAT source.

FRD Requirements Satisfied: 5.3.2.1, 5.3.2.4

Interface: User's server

Input:
See XSPEC

Output:
See XSPEC

Description:
The user can perform the simulation of LAT spectra in two different ways. First, simulated spectral data can be created using XSPEC's 'fakeit' with an average RSP and a background file (perhaps one of a series for different Galactic latitudes). Average RMFs and background files need to be created for users.

Second, the SAE tools can be used to create simulated data. Both the source and underlying background can be created with the simulation tools O1/O2 (=S-03/S-04), and binned with EventBin. RSPGen is used to create the RSP file that can be used in XSPEC. This option will require downloading the SAE.

Simulating and analyzing many simulated spectra will give the user a measure of how well a source's spectral parameters can be determined.

The fidelity of this simulation may not be as high as analyzing data with Likelihood (see S-06)

Candidate: XSPEC

Software Release: Part of SAE; should be available by release 6. However, average RSP and background files must be created.

Testing:
As part of SAE. However, comparisons among the two simulations methods and the likelihood (S-06) should be performed.

7.6 S-06: LAT Simulated Spectral Analysis B

Purpose: Simulates the 3D (spectral-spatial) analysis of a LAT source.

FRD Requirements Satisfied: 5.3.2.1, 5.3.2.4

Interface: User's server

Input:
See Likelihood

Output:
See Likelihood

Description:
The user can use the SAE tools to create and analyze simulated LAT data using Likelihood. Both the source and underlying background can be created with the simulation tools O1/O2 (=S-03/S-04), and the resulting photon (FT1) and pointing/livetime (FT2) files are analyzed as if they were real data.

Simulating and analyzing many simulated datasets will give the user a measure of how well a source's parameters can be determined.

This is the most high fidelity simulation.

Candidate: Likelihood

Software Release: Part of SAE

Testing:
As part of SAE

7.7 S-07: GBM Simulated Spectral Analysis

Purpose: Simulates the spectral analysis of a burst observed by the GBM.

FRD Requirements Satisfied: 5.3.2.1, 5.3.2.4

Interface: User's server

Input:
See XSPEC

Output:
See XSPEC

Description:
The user can use the SAE tools to create and analyze simulated GBM data using XSPEC. Sample GBM RSP files and background PHA files will be available. Thus XSPEC's 'fakeit' can be used.

Simulating and analyzing many simulated spectra many times will give the user a measure of how well a source's spectral parameters can be determined.

Candidate: XSPEC

Software Release: Part of SAE

Testing:
As part of SAE

7.8 S-11: Weekly Timeline Display

Purpose: Posts the weekly science timelines

User: GSSC

FRD requirements satisfied: 5.4.1.3

Interface: Command line—execution may result from a system call by the operations tool that submits the timeline to the MOC.

Input:
Timeline file
Command line arguments:
1. Timeline file name
2. Webpage file name

Output:
Updated webpage
stdout and stderr: Diagnostic messages stating success or failure of the posting, return value:
0 Success
1 Failure due to problems with the timeline file
2 Failure due to problems with the website
3 Failure due to problems with the command line arguments

Description:

The GSSC will produce a preliminary science timeline for a period of a week ~4 weeks before that week, and a final science timeline a few days before the timeline's week begins. This tool will post the most up-to-date timeline available. Note that at any time there will be ~4 planned science timelines spanning ~a month in the future from the present.

The script is started either by the website curator "by hand" or by another script (e.g., the operations tool that submits the timeline to the MOC). In either case, the script must communicate with its caller in the standard way of a UNIX command, i.e., give meaningful return values and error messages.

The script performs the following steps:

1. Find the timeline text and check its integrity (can it be read? does it have the correct length to be a proper timeline file?)
2. Find the HTML file where the timeline is supposed to be posted; rename the existing file to *.old (i.e., change the extension to ".old"); overwrite the existing *.old file.
3. Create a new timeline HTML file by reformatting the timeline text from the input file, adding the necessary headers and footers, etc., and writing it to the file named

as given by command line argument 2.

Software Release: 7

Testing:

For testing the script (a) a correctly formatted timeline file, and (b) a truncated timeline file shall be generated. It shall then be verified that file (a) is correctly posted and that file (b) is correctly identified as incomplete (i.e., it is not posted and an error message and corresponding return value is generated). Furthermore it shall be verified that the script reacts correctly to missing or faulty input.

7.9 S-12: Annual Timeline Display

Purpose: Posts the latest annual science timeline

User: GSSC

FRD requirements satisfied: 5.4.1.3

Interface: Command line

Input:
Timeline file
Command line arguments:
1. Timeline file name
2. Webpage file name

Output:
Updated webpage
stdout and stderr: Diagnostic messages stating success or failure of the posting, return value:
1 Success
2 Failure due to problems with the timeline file
3 Failure due to problems with the website
4 Failure due to problems with the command line arguments

Description:

Every year the Timeline Committee will meet after the peer review panels tentatively accept observing proposals. Using the scheduling tool the Timeline Committee will create a science timeline for the upcoming GI cycle with a resolution of one week (i.e., observations are scheduled for a given week).

The script is started either by the website curator "by hand" or by another script (e.g., the timeline ingest). In any case, the script must communicate with its caller in the standard way of a UNIX command, i.e. give meaningful return values and error messages.

The script performs the following steps:
1. Find the timeline text and check its integrity (can it be read? does it have the correct length to be a proper timeline file?)
2. Find the HTML file where the timeline is supposed to be posted; rename the existing file to *.old (i.e., change the extension to ".old"); overwrite the existing *.old file.
3. Create a new timeline HTML file by reformatting the timeline text from the input file, adding the necessary headers and footers.

Software Release: 7

Testing:

For testing the script (a) a correctly formatted timeline file, and (b) a truncated timeline file shall be generated. It shall then be verified that file (a) is correctly posted and that file (b) is correctly identified as incomplete (i.e., it is not posted and an error message and corresponding return value is generated). Furthermore it shall be verified that the script reacts correctly to missing or faulty input.

7.10 S-13: As-Flown Timeline Display

Purpose:
Displays the GLAST as-flown timeline

User: Scientific Investigator

FRD requirements satisfied: 5.4.1.3

Interface: Command line—execution may result from a system call by the operations tool that ingests the as-flown timeline from the MOC

Input:
As-flown timeline
Command line arguments:

1. Timeline file name
2. Webpage file name

Output:
Updated webpage
stdout and stderr: Diagnostic messages stating success or failure of the posting, return value:

1 Success
2 Failure due to problems with the timeline file
3 Failure due to problems with the website
4 Failure due to problems with the command line arguments

Description:

The GSSC will receive an ASCII as-flown timeline from the MOC. This tool displays the timeline on the GSSC website.

The script will usually be started by the operations tool that ingests and processes the as-flown timeline from the MOC. The script must communicate with its caller in the standard way of a UNIX command, i.e., give meaningful return values and error messages.

The script performs the following steps:

1. Find the timeline text and check its integrity (can it be read? does it have the correct length to be a proper timeline file?)
2. Find the HTML file where the timeline is supposed to be posted; rename the existing file to *.old (i.e., change the extension to ".old"); overwrite the existing *.old file.
3. Create a new timeline HTML file by reformatting the timeline text from the input file, adding the necessary headers and footers, etc..

Software Release: 7

Testing:
For testing the script (a) a correctly formatted timeline file, and (b) a truncated timeline file shall be generated. It shall then be verified that file (a) is correctly posted and that file (b) is correctly identified as incomplete (i.e., it is not posted and an error message and corresponding return value is generated). Furthermore it shall be verified that the script reacts correctly to missing or faulty input.

7.11 S-21: GI Proposal Submission Interface (RPS)

Purpose: Provide the front end for the submission of GLAST GI proposals through the RPS system

User: Scientific Investigator

FRD requirements satisfied: 5.3.2.1

Interface:
The standard system of webforms as used in other RPS applications, e.g., http://cxc.harvard.edu/cgi-bin/RPS/Chandra/RPS.pl

Input:
As for other missions, the GLAST proposal will require the following sections:

a) Cover page (proposer name and affiliation, proposal category, joint proposals, proposal title and abstract)
b) General Form (list of co-investigators, institute endorsement)
c) Target Form (target description, observing mode, observing time, observing constraints, ToO details)

Output:
As for other missions, the information entered via the RPS forms shall be converted into properly formatted proposal texts in LaTeX, Postscript or PDF format, while the data will be stored in a GSSC database.

Description:
For a description of RPS refer to http://heasarc.gsfc.nasa.gov/RPS/ .

Testing:
The GLAST proposal submission shall be tested by installing the system on a non-public site and submitting a series of correct and faulty proposals and subsequently verifying that the system reacts appropriately.
In a second stage, the system shall be published to the GLAST collaboration during a data challenge with the request to the members to submit “fake” proposals in an effort to perform a stress test on the system.

7.12 S-31: Target of Opportunity Proposal Submission Interface (RPS)

Purpose:
Provide the front-end for the submission of (a) pre-approved and (b) non-pre-approved ToO observation proposals

User: Scientific Investigator

FRD requirements satisfied: 5.4.1.5.1

Interface: Modified RPS through website

Input:

a) For pre-approved ToO proposals
   i) Cover page (proposer name and affiliation, proposal ID, abstract explaining why ToO criterion has been met)
   ii) Target Form (target description, observing mode, observing time, observing constraints, ToO details)
b) For non pre-approved ToO proposals
   i) Cover page (proposer name and affiliation, abstract explaining why ToO should occur)
   ii) Target Form (target description, observing mode, observing time, observing constraints, ToO details)

Output:

a. Page to Project Scientist (or designee) and GSSC duty scientist
b. As for a standard proposal, the TOO proposer will receive texts in LaTeX, Postscript or PDF format that will verify that the request has been received with the correct information.
c. Request is entered into database

Description:
The GSSC website will have an RPS-based interface (http://heasarc.gsfc.nasa.gov/RPS/) through which a scientist can request a TOO. The request is sent to the Project Scientist (who will have the authority to authorize the TOO) and the GSSC duty scientist (who will evaluate the request) through the paging system.

Software Release: 5

Testing:
The GLAST proposal submission shall be tested by installing the system on a non-public site and submitting a series of correct and faulty proposals and subsequently verifying that the system reacts appropriately.

In a second stage, the system shall be published to the GLAST collaboration during a data challenge with the request to the members to submit “fake” proposals in an effort to perform a stress test on the system.

7.13 S-32: Approved Target of Opportunity Display

Purpose: Posts the abstract and scheduling information for an approved ToO

User: GSSC

FRD requirements satisfied: 5.4.1.5.7, 5.4.2

Interface: Command line—execution may result from a system call by the operations command that sends the TOO order to the MOC

Input:

a) Abstract file name
b) HTML file name
c) Title text (in quotation marks)

Output:

HTML file with the abstract and scheduling information
stdout and stderr—Return values stating success or failure of the posting:

0 Success
1 Failure due to problems with the abstract file
2 Failure due to problems with the website
3 Failure due to problems with the command line arguments.

Description:

The script is triggered by the operations tool that submits TOO requests to the MOC. The script must communicate with its caller in the standard way of a UNIX command, i.e., give meaningful return values and error messages.

The script performs the following steps:

a) Find the abstract file (a plain text file) and check its integrity (can it be read?, is it non-empty?)
b) Create a new ToO HTML file by adding header and footer and the appropriately marked up title to the abstract body and write it in the default directory where all ToO abstracts HTML files are stored.
c) Find the HTML file that links to the individual TOO HTML files; if the file already exists, rename it to name.old (i.e., append ".old"; if the .old file already exists, overwrite it).
d) Create a new HTML file that links to the individual TOO HTML files by copying the "*.old" file and appending a link to the newly created ToO abstract HTML file.

Software Release: 7

Testing:
For testing, (a) a dummy abstract and (b) an empty file shall be created. It shall then be verified that file (a) is correctly posted and that file (b) is correctly identified as incomplete (i.e. it is not posted and an error message and corresponding return value is generated). Furthermore it shall be verified that the script reacts correctly to missing or faulty input.

7.14 S-41: LAT Observations Request Interface (RPS)

Purpose: Interface for the LAT team to request calibration observations

User: LAT team

FRD requirements satisfied: 5.4.1.4.2

Interface: Modified RPS through website

Input:

a) Cover page: ISOC scientist requesting observation, description of and reason for calibration observation
b) Target Form: Target coordinates, observing mode, observing time, observing constraints

Output:

a. Request submitted to GSSC duty scientist
b. Request is entered into database
c. Requesting scientist receives confirmation with inputted data

Description:

From time to time the LAT team will request calibration observations. An RPS interface will be created for this purpose. Although this is strictly an operations tool, this tool is included here because of its similarity to the TOO Proposal Submission Interface.

Software Release: 6

Testing:

The LAT Observation Request Interface shall be tested by installing the system on a non-public site and submitting a series of correct and faulty requests and subsequently verifying that the system reacts appropriately.

In a second stage, the system will be made available to the LAT team.

7.15 S-51: Count Map Generator

Purpose: Generates count maps. The tool will be run periodically by a software pipeline

FRD Requirements Satisfied: 5.6.4

Interface: Command line—execution may result from a system call by pipeline

Input:

Location
Time range
Region size
Maximum inclination angle

Output:

Count map

Description: This tool can be used both by the GSSC in its pipeline and by users.

Candidate: EventBin with web interface

Software Release: 7

Testing:

7.16 S-52: Exposure Map Generator

Purpose: Plots the exposure map for the entire sky and select regions. The tool will be run periodically by a software pipeline.

FRD Requirements Satisfied: 5.6.4

Interface: Command line—execution may result from a system call by pipeline

Input:

Location
Time range
Region size
Maximum inclination angle

Output:

Sky exposure map

Description: This tool can be used both by the GSSC in its pipeline and by users. This tool will satisfy the requirement that the GSSC plot exposure maps periodically.

Candidate: Code behind S-02 run by a pipeline

Software Release: 7

Testing:

7.17 S-53: LAT Diffuse Emission Display

Purpose: Post the latest LAT background model

User: GSSC

FRD requirements satisfied: 5.3.3.2, 5.4.2

Interface: Command line—execution may result from a system call by the ingest of an updated diffuse emission model

Input:
Diffuse background model (format: FITS)
Command line arguments:

a) Background file name
b) Webpage file name
c) Title text (in quotation marks)

Output:
Webpage with plot of the background model
stdout and stderr—Return values stating success or failure of the posting:

0 Success
1 Failure due to problems with the background model file
2 Failure due to problems with the website
3 Failure due to problems with the command line arguments

Description:

The script is started either by the website curator "by hand" or by the script that ingests the new background model. In either case the script must communicate with its caller in the standard way of a UNIX command, i.e., give meaningful return values and error messages.

The script performs the following steps:

a) Find the background model file and check its integrity (can it be read?, has it the right length to be a proper background model file?)
b) Find the HTML file where the background model file is supposed to be posted (see second command line argument); if the HTML file already exists, rename it to name.old (i.e. append ".old"); if the .old file already exists overwrite it.
c) Copy the background model file to the ftp server from which it is supposed to be served
d) Create a new HTML file by editing the .old file with a screen editor (e.g., SED) and replacing the links for the current background model file appending a link to the new file (using argument 3 as text in the link).

Software Release: 6

Testing:
For testing the script any file can play the role of the background model file. It shall be verified that a non-empty file is correctly posted and that an empty file is correctly identified as incomplete (i.e., it is not posted and an error message and corresponding return value is generated). Furthermore it shall be verified that the script reacts correctly to missing or faulty input.

7.18 S-54: GRB Map Publisher

Purpose: Posts the latest GRB location map.

User: GSSC

FRD requirements satisfied: 5.4.2, 5.6.4

Interface: Command line—execution may result from a system call by the ingest of new GRB data

Input:
New GRB location

Output:
Map on GSSC website
stdout and stderr—Return values stating success or failure of the posting:

0 Success
1 Failure due to problems with the ephemeris file
2 Failure due to problems with the website
3 Failure due to problems with the command line arguments

Description:

This tool plots the location of each new burst as the burst data is received. The tool does NOT update the positions when the GBM provides an updated catalog; this will occur infrequently enough that the maps can be updated manually. The script is started by the ingest of data from a new burst. The script must communicate with its caller in the standard way of a UNIX command, i.e., give meaningful return values and error messages.
The script performs the following steps:

a) Adds new burst location to file with burst locations.
b) Creates GIF map from burst location file.
c) Finds the HTML file where the map is supposed to be posted; if the file already exists, renames it to *.old (i.e., append ".old"), if the *.old file already exists, overwrites it.
d) Copies the new map to the location of the old map, creating a new GRB map HTML file.

Software Release: 7

Testing:
The test can be carried out by adding a new burst to an existing burst location file.

7.19 S-55: GRB Lightcurve Display

Purpose:
Displays a lightcurve for each GRB

User: GSSC

FRD requirements satisfied: 5.4.2, 5.6.4

Interface: Command line—execution may result from a system call by the ingest of new GRB data

Input:
GBM lightcurve file

Output:
Lightcurve on website
stdout and stderr—Return values stating success or failure of the posting:

0 Success
1 Failure due to problems with the lightcurve file
2 Failure due to problems with the website
3 Failure due to problems with the command line arguments.

Description:
The GSSC plans to create a webpage for each burst. This script is started by the ingest of a GBM lightcurve file for a particular burst. The script must communicate with its caller in the standard way of a UNIX command, i.e., give meaningful return values and error messages.
The script performs the following steps:

a) Identify the burst from keywords in the GBM lightcurve file
b) Create gif files with burst lightcurves
c) If a webpage for the burst exists, post the lightcurves on this webpage
d) If the webpage does not yet exist, create the webpage and post the lightcurve on the webpage.

Software Release: 7

Testing:
Run all combinations of a properly and improperly formatted lightcurve file with and without an existing burst webpage.

7.20 S-56: GCN Post

Purpose:
Receives, archives and posts on a webpage GLAST GCN Notices and Circulars.

User: GSSC

FRD requirements satisfied: 5.4.2, 5.6.4, 5.7.1.8

Interface: Execution triggered by the ingest of new GLAST-produced GCN Notices and Circulars

Input:

g. GCN Notices from GCN (e-mail or socket)
h. GCN Circulars by e-mail from GCN

Output:
Burst webpage with GCN Notice or Circular
stdout and stderr—Return values stating success or failure of the posting:

1) Success
2) Failure due to problems with the lightcurve file
3) Failure due to problems with the website
4) Failure due to problems with the command line arguments.

Description:

This tool will receive all GCN Notices as if it were a telescope site, and then identify and archive the GLAST-produced Notices. Similarly, the tool will receive GCN Circulars, and then identify and archive the GLAST-produced Circulars.

The GSSC plans to create a webpage for each burst. This tool will post all GLAST-produced GCN Notices and Circulars for a particular burst on the webpage for that burst. The script must communicate with its caller in the standard way of a UNIX command, i.e., give meaningful return values and error messages.
The script performs the following steps:

1) Monitor the GCN for Notices or Circulars
2) Identify GLAST-produced GCN Notices or Circulars from keywords in the Notice or Circular
3) If a webpage for the burst exists, post the GCN Notice or Circular on this webpage
4) If the webpage does not yet exist, create the webpage and post the GCN Notice or Circular on the webpage.

Candidate: GCN front-end software and custom scripts (available from GCN)

Ops Software Release: 3

Testing:

1. Ingest:
    a. Tool monitors GCN
    b. Tool intercepts and ingests GCN Notices from desired mission
    c. Tool intercepts but does not ingest GCN Notices from other missions
    d. Tool intercepts and ingests GCN Circulars from desired mission
    e. Tool intercepts but does not ingest GCN Circulars from other missions
2. Posting—with and without an existing burst webpage.

7.21 S-57: Point Source Monitor

Purpose: Monitors a list of point sources

FRD Requirements Satisfied: 5.6.4

Interface: TBD

Input: TBD

Output: TBD

Description: This is the software the LAT team will develop and then use during the first year. Assuming the GSSC takes over this monitoring during the second and subsequent years, the GSSC will adopt the LAT's software. Presumably the software will post lightcurves to a website.

Candidate: Inherited from LAT team

Software Release: NA

Testing:

7.22 S-61: Help Desk Question Submission

Purpose: Enables users to submit questions about GLAST analysis to the GSSC via a webform

User: Scientific Investigator

FRD requirements satisfied: 5.3.3.3

Interface: Web form

Input:
a) User name
b) User e-mail address
c) Subject
d) Question/comment text

Output:
A confirmation message shall be displayed on the webpage once the investigator's question has been submitted to the GSSC.

Description:
An email message shall be composed from the texts in the four input fields and sent to the helpdesk e-mail address. A confirmation e-mail shall be sent to the user's e-mail address without a valid reply address (in order to protect the help desk e-mail address from spam).

If any of the input fields were not filled in when the send button is clicked, an error message shall appear on the screen explaining what is missing.

Software Release: 6

Testing:
The submission shall regularly be tested by submitting dummy requests.

7.23 S-62: Help Desk Response Administration

Purpose:
Transfers the questions submitted via the GSSC helpdesk (S-61) to duty scientists responsible for answering them, tracks the response time, archives subsequent correspondence.

User: GSSC

FRD requirements satisfied: 5.3.3.3

Interface: Command line or GUI

Input:
Via a system of commands or selecting GUI menu items and buttons, the user shall be able to manipulate the help desk responses. See "Description" below.

Output:
See "Description" below.

Description:
The question text coming from S-61 shall be received as an e-mail at a special mail server (the mailgate). This mailgate shall

1. Send an e-mail acknowledgement (with blind reply address) to the person submitting the request
2. Send the question as an email to the duty scientist
3. Append the question to the "active directory"
4. Assign the duty scientist as the default person to the case

The duty scientist shall then be able to:

1. View the active directory
2. Modify the status of an entry (assign a different person to a question)
3. Declare the case as resolved

If a case is declared as resolved, the system shall move the entry to the "resolved directory," i.e., the archive. At the time of resolution, the time difference between question submission and the resolution shall be recorded and entered into a histogram.

Software Release: 6

Testing:
Initially the system shall be tested in a team of five GSSC members where two members represent the user community and three members represent the duty scientists. The "community" shall then submit of the order of 50 questions. For each question, the

"community" shall measure the time taken to answer the question such that these results can be compared to the response times recorded by the system.

The system shall be tested further by opening it to the GLAST community during data challenges and encouraging people to submit real questions concerning the science tools.

7.24 S-63: FAQ Access

Purpose: Enables the website user to browse and search the list of frequently asked questions compiled from the GSSC helpdesk submissions

User: Scientific Investigator

FRD requirements satisfied: 5.3.3.3

Interface: Web form

Input:
Keyword(s)

Output:
Web page containing links to the FAQ entries that contain the keyword

Description:

The FAQ responses shall be extracted by GSSC scientists from the archive of S-62. The responses shall be presented in a flat web page with three-level hierarchy with anchor points at each response.

A search engine shall take the search keywords and find the corresponding text in the FAQ webpage. The result of the search shall then be presented to the user as a list of links to the anchor points corresponding to the entries on the FAQ page that contain the keywords.

Software Release: 6

Testing:

A dummy FAQ list shall be assembled from the questions submitted in the testing of S-62. This list shall then be searched and the results verified to be correct.

8 GSSC Backup Level 1 Processing

The GSSC will maintain backup copies of the Level 1 processing pipelines for use in case of an emergency (FRD requirement 5.6.5).

Table 9-1: Backup Level 0 to Level 1 Data Processing Pipelines			
Tool Name	**Description**	**Source**	**Release**
LAT pipeline	Copy of LAT processing pipeline for emergency processing	Developed by LAT.	GSSC6
GBM pipeline	Copy of GBM processing pipeline for emergency processing	Developed by GBM	GSSC6

9 GBM-Specific Analysis Tools

The GBM instrument team is responsible for developing the GBM-specific tools. Since there are only two such tools (in addition to database access utilities), and there is currently no document describing these tools, we include a description here for completeness.

9.1 Background Creation

Purpose: Create a background model for GBM burst spectra.

Databases used: D11 (GBM Burst Data)

Comments: This tool will fit a polynomial-in-time background model for each GBM energy channel using user-specified time intervals before and after the burst. The method exists in both IDL and Fortran, and needs to be translated into C++.

9.2 DRMgen

Purpose: Create a GBM DRM for a burst.

Databases used: D15 (GBM DRM Data), D16 (GBM Timeline)

Comments: M. Kippen will provide a C++ tool.

7/8/2004

ACRONYM LIST

BAP	Burst Alert Processor
CCB	Configuration Control Board
CM	Configuration Management
ETE	End-to-End
FOT	Flight Operations Team
GBM	GLAST Burst Monitor
GCN	Gamma-ray burst Coordinates Network
GIOC	GBM IOC
GOWG	GLAST Operations Working Group
GLAST	Gamma-Ray Large Area Space Telescope
GRT	Ground Readiness Test
GSFC	Goddard Space Flight Center
GSSC	GLAST Science Support Center
HEASARC	High Energy Astrophysics Science Archive Research Center
IOC	Instrument Operations Center
IRF	Instrument Response Function
LAT	Large Area Telescope
LHEA	Laboratory for High Energy Astrophysics
LIOC	LAT IOC
MOC	Mission Operations Center
NSSTC	National Space Science and Technology Center
OGIP	Office of Guest Investigator Programs
PDMP	Project Data Management Plan
SLAC	Stanford Linear Accelerator Center
TIM	Technical Exchange Meeting
TOO	Target Of Opportunity